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GSFC PREFERRED PARTS LIST

PPL-15

(NASA-CR-164427) GSFC PREFERRED PARTS LIST
PPL-15 (Sperry Rand Corp.) 88 p
HC A05/MF A01

N81-27327

CSCL 131

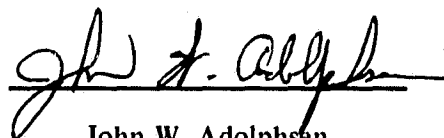
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OCTOBER, 1980

GODDARD SPACE FLIGHT CENTER


This document was prepared by the Product Assurance Division of the Goddard Space Flight Center and the Preferred Parts Mission of the Sperry Support Services Facility, Sperry Corp.

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October, 1980

To: Holders of GSFC Preferred Parts List
From: John W. Adolphsen, Head, Preferred Parts Staff, Parts Branch, PAD
Subject: Issuance of GSFC Preferred Parts List No. 15

GSFC Preferred Parts List PPL-15 of October, 1980 supersedes PPL-14, which should now be discarded.

John W. Adolphsen



PREFACE

PURPOSE

This document contains a listing of preferred parts, part upgrading procedures, part derating guidelines, and part screening procedures to be used in the selection, procurement, and application of parts for GSFC space systems and ground support equipment.

AUTHORITY

The GSFC PPL is authorized and invoked by Goddard Management Instructions (GMI) 5330.6, *Implementation of the Goddard Space Flight Center Parts Program*.

STANDARDIZATION

MIL-STD-975, the NASA Standard (EEE) Parts List (SPL), is the prime reference document for preferred electronic parts for NASA. The GSFC Preferred Parts List (PPL-15) complements MIL-STD-975 by listing additional device types and part categories not included in MIL-STD-975. All parts or styles listed in MIL-STD-975C are identified in PPL-15.

QUALITY LEVELS

Consistent with MIL-STD-975, PPL-15 specifies two levels of quality, and these levels are defined essentially in the same manner. Grade 1 parts are intended for critical flight and mission-essential ground support applications where failure would cause major mission degradation and part performance is critical to mission success or safety. Grade 2 parts are for non-critical flight and non-mission-essential ground support applications. In some cases, a SPL Grade 2 part has been listed as a Grade 1 level part in the PPL. Where any conflicts exist between the SPL and PPL-15, PPL-15 takes precedence.

The parts listed in this document meet the requirements of a Military or NASA Center Specification. When a PPL listed part is purchased by GSFC, the specification listed for the part and the recommended manufacturer(s) or the manufacturers on the QPL for the part must be referenced in the procurement request.

All specifications listed in the PPL are maintained on file in the Parts Branch for reference purposes. GSFC personnel can obtain copies of specifications through their division offices from the Product Assurance Library, code 311A, telephone (301) 344-7240. Contractors, approved domestic and foreign experimenters, and international cooperative project working groups can obtain copies of the PPL and copies of referenced documents, except MIL specifications, by a written request via the cognizant project office. All others may obtain copies of the PPL through the National Technical Information Service (NTIS), Springfield, VA 22161.

REVISIONS

The PPL will be reissued during 1982. Portions may be changed and updated prior to that date, as required. Parts not now listed, for which a substantial or critical usage is anticipated, should be brought to the attention of the Preferred Parts Staff so that those parts may be considered as candidates for evaluation and possible future listing in the NASA SPL or the GSFC PPL. Call (301) 344-8896 or (301) 344-8830 or (301) 344-6633.

PART CHARACTERISTICS

Electrical characteristics are specified at 25°C ambient, unless otherwise noted.

CRITERIA FOR LISTING PARTS

Parts are listed in the PPL based on the following criteria:

- (1) they can be procured to a high reliability military or NASA specification;
- (2) they have complied with an approved series of qualifying criteria;
- (3) they are judged by the GSFC Parts Branch to be available and not redundant to other parts in the GSFC PPL or NASA SPL.

USER RESPONSIBILITY

GMI 5330.6, Implementation of the Goddard Space Flight Center Parts Program, should be reviewed by all those required to use the GSFC PPL. This means that:

- (a) In designing new systems, users shall use the SPL and PPL as the prime reference sources to select part types known to be more reliable than others.
- (b) The part should be purchased to the specifications referenced in the SPL or PPL.
- (c) Users should consult their project parts engineer for information concerning the detailed requirements on the information that must be included in or accompany a Non-Standard Parts Approval Request.

The SPL and PPL serve the Center as a whole covering both Flight and Ground Support Equipment applications and needs. It is the responsibility of the user, the product assurance engineer, and flight assurance manager to insure that the proper grade level parts are selected from the SPL and PPL commensurate with the criticality assigned to each project or system.

RELIABILITY NOTES

Screening

Improvement in the reliability of electronic parts can be realized through screening. This is demonstrated by most ER (Established Reliability) and TXV (Testing Extra, Visual Pre-cap

Inspection) specification programs of the military, which are specified in the SPL and PPL wherever appropriate. The TXV specifications cover semiconductors and upgrade existing MIL devices by adding a 100% burn-in as part of the screening procedure and requiring that a visual inspection be performed prior to the lidding of the device. The ER specifications similarly cover a variety of components such as resistors and capacitors, and additionally define various failure rate qualification levels. Screening of non-TXV/ER parts to prepare them for flight use is required (see Appendix C). However, preference must be given to the listed TXV/ER parts before considering the use of the equivalent JAN part which is subsequently screened, inasmuch as more protective screens, such as pre-cap visual inspection, often can be added, as part of the total manufacturing process, than can be prescribed in Appendix C. TXV devices must be rescreened in accordance with the applicable TX detail specification, because of semiconductor quality problems.

ESTABLISHED RELIABILITY

The SPL and PPL, wherever feasible, list capacitors, inductors, relays, and resistors procurable to military "Established Reliability" (ER) specifications. These specifications provide known levels of reliability (failure rates) which have been demonstrated under controlled test conditions, as specified in the military specifications, and expressed as percent failures per thousand hours (%/1000 hours). The failure rates are established at rated stress conditions and at 60 to 90% confidence levels, depending upon the particular part and military specifications.

COMPONENT QUALITY and MIL-HDBK-217C

MIL-HDBK-217C, *Reliability Prediction of Electronic Equipment*, gives various equations and tables to calculate the failure rate of a component in a system. The general form of the failure rate equation is:

$$\lambda_p = \lambda_b (\pi_E \times \pi_Q \times \Pi)$$

where

λ_p = Part failure rate (Failures/10⁶ hours)

λ_b = Base failure rate - relating the influence of electrical and temperature stresses on the part.

π_E = System Environment Factor

π_Q = Quality Factor

Π = Product of other factors unique to each device type.

π_E is based on the application of a part, whether flight or ground equipment. π_Q is based on the quality of the purchased part. These factors appear in the reliability models for all component types. The following tables list representative quality factors for the quality levels of components procured for GSFC projects.

MONOLITHIC MICROCIRCUITS

<u>QUALITY LEVEL DESIGNATION</u>	<u>QUALITY FACTOR, π_Q</u>
MIL-M-38510, Class S	1
MIL-M-38510, Class B	2
MIL-STD-883, Method 5004, Class B	5
Vendor Version of 5004	10
MIL-M-38510, Class C	16
Commercial Hermetic Package	150
Commercial Plastic Package	300

DIODES/TRANSISTORS

<u>QUALITY LEVEL DESIGNATION</u>	<u>QUALITY FACTOR, π_Q</u>
JANTXV	0.12
JANTX	0.24
JAN	1.2
Commercial Hermetic Package	6.0
Commercial Plastic Package	12.0

"ER" PASSIVE COMPONENTS

<u>QUALITY LEVEL DESIGNATION</u>	<u>FAILURE RATE LEVEL (%/1000 hrs.)</u>	<u>QUALITY FACTOR, π_Q</u>
M M	1.0	1.0
P	0.1	0.3
R	0.01	0.1
S	0.001	0.03

Although the Failure Rate Levels for "ER" parts differ by factors of 10, MIL-HDBK-217C states that field data shows the true failure rates to vary by a factor of 3 and the Quality Factors have been adjusted to reflect this fact.

PART DERATING

Conservative application stresses are an important design tool for decreasing part degradation and improving failure rates, and prolonging the useful life of parts. For guidance, recommended part derating factors are tabulated in Appendix B.

PART UPGRADING

For some types of devices listed in the SPL and PPL, the listed Grade 1 devices are not available. Appendix A gives guidelines for upgrading Grade 2 devices to an acceptable level for use as a substitute for the missing Grade 1 device. In all cases, upgrading must be approved by the Project Parts engineer.

PARTS INFORMATION DIRECTORY

Assistance in the selection of parts, parts specifications, manufacturers surveys, incoming inspection, screening evaluation tests and failure analysis services for all parts are available from the Parts Branch of the Product Assurance Division.

For assistance on electronic parts problems and questions in direct support of specific projects, users should contact the cognizant parts specialist assigned to the respective project. If unknown, the identity can be determined by contacting the project office.

For general evaluation information of electronic parts, part specifications, and part qualification, users may contact a specialist in the particular part category, as listed below:

<u>PART CATEGORY</u>	<u>SPECIALIST</u>	<u>TELEPHONE</u> (301) 344-
Capacitors	P. Jones	5910
Connectors	J. Lawrence	5640
Crystals	N. Tyson	7113
Diodes	M. Robertson	6165
Filters	P. Jones	5910
Fuses	L. Buyer	5910
Inductors	L. Buyer	5910
Microcircuits	M. Baluck	5987
PC Boards	H. Chernikoff	5984
Relays	J. Lawrence	5640
Resistors	L. Buyer	5910
Solder	H. Chernikoff	5984
Thermistors	L. Buyer	5910
Transformers	L. Buyer	5910
Transistors	M. Robertson	6165
Wire and Cable	J. Lawrence	5640
All	Preferred Parts Staff, Sperry Support Services	{ 6633 8830

Additional services in support of the GSFC parts program are:

<u>FUNCTION</u>	<u>CONTACT</u>	<u>TELEPHONE</u> (301) 344-
Electronic Parts Qualification	J. Adolphsen	8896
Testing, Maintenance of the PPL		
Electronic Parts Incoming Test, Inspection, and Screening	N. Tyson	7113
Data Systems	G. Ritter	7113
Failure Analysis	N. Tyson	7113
Quality Surveys	{ Cognizant Office of Flight Assurance Representative	7669
Procurement Request Review		
Packaging Process Specialist	H. Chernikoff	5984

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Index of Preferred Capacitors

Military Style	Description	Control Specification	Refer To
CCR	Ceramic, Temperature-compensating, Fixed	MIL-C-20	MIL-STD-975
CDR	Ceramic, Chip, Multiple-layered, Fixed Styles CDR01, 02, 03 Styles CDR04, 05, 06	MIL-C-55681	Pages 01-2, 01-3 MIL-STD-975
CKR	Ceramic, Fixed	MIL-C-39014	MIL-STD-975
CLR	Tantalum (non-solid) electrolytic, Fixed	MIL-C-39006	MIL-STD-975
CRH	Plastic (metalized), Fixed	MIL-C-8342	MIL-STD-975
CSR	Tantalum (solid) electrolytic, Fixed	MIL-C-39003	MIL-STD-975
CYR	Glass, Fixed Styles CYR10, 15, 20, 30 Styles CYR13, 41, 42, 43, 51, 52, 53	MIL-C-23269	MIL-STD-975 Pages 01-4 to 01-12

NOTES:

- For part styles listed in MIL-STD-975, GSFC makes the following recommendations:
 - CLR styles with ratings above 100 volts are not recommended for Grade 1 applications.
 - CKR style 329 recommended by GSFC are limited to maximum capacitance values as follows:

CKR05-33,000 pf	CKR11-4,700 pf	CKR14-47,000 pf
CKR06-320,000 pf	CKR12-10,000 pf	CKR15-180,000 pf
 - CKR styles for use in Grade 1 applications shall be purchased to revision C of MIL-C-39014.
 - CSR13 styles rated for 100 volts rather than 75 volts should be used where identical capacitance values are available at both voltages.
 - CSR33 styles are not recommended for power line application where parts see power cycling or current surge conditions, CLR79 styles are preferred for such applications.

MIL-C-55681, CAPACITORS

Fixed, Chip, Multiple Layer, Unencapsulated, Ceramic Dielectric, Established Reliability¹

Part Number example: <u>CDRXX</u> <u>BV*</u> <u>XXX</u> <u>W*</u> <u>T*</u> <u>S</u> <u>Z*</u>													
Military Style	See Page 01-	Capacitance		DC Voltage Ratings W	Characteristics BV	Maximum D.F. (%) for	Insulation Resistance	Dimensions (Millimeters, Max.)			Grade 1 FRL	Grade 2 FRL	Manufacturer
		Range (pF)	Tolerances T					L	W	T			
CDR01	3	10-4700 220-22000 330-68000	J, K, M	A, B	BP, BX	0.15 2.5	100 K megohm for C < 10 nF 1 K megohm-μF for C ≥ 10 nF3	2.41 4.95 4.95	1.65 1.65 2.41	1.40 1.40 2.03	R	P	QPL-55681

STYLE - "CDR"
Multiple layers, fixed, ceramic dielectric, encapsulated, established reliability. XX = size code (see dimensions)

RATED TEMPERATURE AND VOLTAGE - TEMPERATURE LIMITS - "B" indicates the rated temperature range of 218K to 358K; "V" the voltage - temperature limits in accordance with the following table:

V	Capacitance Change referenced to 298K
P	0 Volts Applied
X	0 ± 30 ppm/K ± 15%
	Rated Volts Applied
	0 ± 30 ppm/K + 15% - 25%

CAPACITANCE - The nominal value, expressed in picofarads; the first two digits represent significant figures and the last digit specifies the number of zeros to follow.

W	Volts, DC
A	50
B	100

RATED VOLTAGE - for continuous operation at 358K, is specified in accordance with the following table:

T	(± %)
J	5
K	10
M	20

CAPACITANCE TOLERANCE - is specified in accordance with the following table:

Finish	
S	Solder
N	Gold

TERMINATION FINISH - "S"2

FAILURE RATE LEVEL (FRL) - is specified in accordance with the following table:

Z	(%/1000 hrs.)
P	0.1
R	0.01

NOTES:

- For helpful information dealing with the handling, use, and protection of these chips, refer to AID No. 01-01 available from Parts Branch Library (301) 344-7240.
- MIL-C-55681 specifies additional codes and finishes for these devices for soldering or thermocompression bonding. These parts are not intended for welding.
- Insulation resistance = X/C, where X = 1000 megohm-microfarads and C is in microfarads.

MIL-C-55681, STYLE CDR01

Fixed, Chip, Ceramic Dielectric, Established Reliability

Part Number ^{1,2}	Capacitance		Characteristic BV*	Rated Voltage (volts, dc)
	Nominal Value (pF)	Tolerance T*		
CDR01BP100BT*SZ* 120BT*SZ* 150BT*SZ* 180BT*SZ* 220BT*SZ*	10	J,K	BP	100
	12	J		
	15	J,K		
	18	J		
	22	J,K		
CDR01BP270BT*SZ* 330BT*SZ* 390BT*SZ* 470BT*SZ* 560BT*SZ*	27	J		
	33	J,K		
	39	J		
	47	J,K		
CDR01BP680BT*SZ* 820BT*SZ* 101BT*SZ* 121BT*SZ* 151BT*SZ* 181BT*SZ*	56	J		
	68	J,K		
	82	J		
	100	J,K		
CDR01BX221BT*SZ* 271BT*SZ* 331BT*SZ* 391BT*SZ* 471BT*SZ*	120	J,K		
	150	J,K		
	180	J,K		
	220	K,M		
CDR01BX561BT*SZ* 681BT*SZ* 821BT*SZ* 102BT*SZ* 122BT*SZ*	270	K	BX	100
	330	K,M		
	390	K		
	470	K,M		
CDR01BX152BT*SZ* 182BT*SZ* 222BT*SZ* 272BT*SZ* 332BT*SZ*	560	K		
	680	K,M		
	820	K		
	1,000	K,M		
CDR01BX392AT*SZ* 472AT*SZ*	1,200	K		
	1,500	K,M		
	1,800	K		
	2,200	K,M		
CDR01BX392AT*SZ* 472AT*SZ*	2,700	K		
	3,300	K,M		
	3,900	K		
	4,700	K,M		
CDR01BX472AT*SZ*				50

MIL-C-55681, STYLE CDR02

Fixed, Chip, Ceramic Dielectric, Established Reliability

Part Number ^{1,2}	Capacitance		Characteristic BV*	Rated Voltage (volts, dc)
	Nominal Value (pF)	Tolerance K*		
CDR02BP221BT*SZ* CDR02BP271BT*SZ* CDR02BX392BT*SZ* 472BT*SZ* 562BT*SZ* 682BT*SZ* 822BT*SZ* 103BT*SZ* 123AT*SZ* 153AT*SZ* 183AT*SZ* 223AT*SZ*	220	J,K	BP	100
	270	J		
	3,900	K,M		
	4,700	K		
CDR02BX123AT*SZ* 153AT*SZ* 183AT*SZ* 223AT*SZ*	5,600	K,M	BX	100
	6,800	K,M		
	8,200	K		
	10,000	K,M		
CDR02BX123AT*SZ* 153AT*SZ* 183AT*SZ* 223AT*SZ*	12,000	K		50
	15,000	K,M		
	18,000	K		
	22,000	K,M		

MIL-C-55681, STYLE CDR03

Fixed, Chip, Ceramic Dielectric, Established Reliability

Part Number ^{1,2}	Capacitance		Characteristic BV*	Rated Voltage (volts, dc)
	Nominal Value (pF)	Tolerance T*		
CDR03BP331BT*SZ* 391BT*SZ* 471BT*SZ* 561BT*SZ* 681BT*SZ* 821BT*SZ* 102BT*SZ*	330	J,K	BP	100
	390	J		
	470	J,K		
	560	J		
CDR03BX123BT*SZ* 153BT*SZ* 183BT*SZ* 223BT*SZ* 273BT*SZ* 333BT*SZ* 393AT*SZ* 473AT*SZ* 563AT*SZ* 683AT*SZ*	680	J,K		100
	820	J		
	1,000	J,K		
	12,000	K		
CDR03BX123BT*SZ* 153BT*SZ* 183BT*SZ* 223BT*SZ* 273BT*SZ* 333BT*SZ* 393AT*SZ* 473AT*SZ* 563AT*SZ* 683AT*SZ*	15,000	K,M		50
	18,000	K		
	22,000	K,M		
	27,000	K		
CDR03BX393AT*SZ* 473AT*SZ* 563AT*SZ* 683AT*SZ*	33,000	K,M	EX	50
	39,000	K		
	47,000	K,M		
	56,000	K		
CDR03BX393AT*SZ* 473AT*SZ* 563AT*SZ* 683AT*SZ*	68,000	K,M		

NOTES:

1. Refer to Page 01-2; Complete part number must include the following:
S - Termination finish symbol
T* - Capacitance tolerance symbol
Z* - Failure rate level symbol
2. For helpful information dealing with the handling, use, and protection of these chips, refer to AID No. 01-01, available from the Parts Branch Library.

MIL-C-23269, CAPACITORS **Fixed, Glass Dielectric, Established Reliability**

Part Number example: <u>M23269</u> / <u>XX</u> <u>XXXX</u>																
M-Number - identifies "CYR" fixed, glass dielectric, established reliability capacitors conforming to MIL-C-23269.				/XX - identifies the appropriate military specification sheet that uniquely specifies the capacitor family.				XXXX - uniquely specifies the nominal capacitance value, capacitance tolerance, rated dc voltage, and failure rate level (%/1000 hours).								
Part Number	Military Style	See Page 01-	Capacitance Range (pF)	Dissipation Factor (%)	Rated Voltage (volts, dc)	Temperature		Insulation Resistance (megohms)	Configuration		Manufacturer					
						Range °C	Coefficient (ppm/°C)		Case Type	Lead Type						
M23269/05	CYR13	5, 6	0.5-300	0.7, 0.3, 0.1	300, 500	-55°C to +125°C	105±25	500 K	Rectangular glass, hermetic	Axial or Radial	QPL-23269					
	CYR41	7	0.5-1000		100		0±25			Radial						
	CYR42	8	0.5-300		50-500					Axial						
M23269/09	CYR43	9	330-1200	0.1	50-300	-55°C to +125°C	140±25	100 K	Rectangular -epoxy	Axial	QPL-23269					
	CYR51	10, 11	1-560	0.2, 0.1	300											
	CYR52	12	620-1000													
M23269/10	CYR53	12	1100-2400	0.1						Radial	M					

NOTES:

- These parts are not available at FRL "R" at this time. If these parts must be used, use Grade 2 parts and consult parts engineering for further reliability information on these parts.

M23269/05, STYLE CYR13
Fixed, Glass Dielectric, Established Reliability

Capacitance		Rated Voltage (volts, dc)	Part Number: M23269/05-	
Value (pF)	Tolerance (±)		Grade 1 FRL = R(0.01)	Grade 2 FRL = P(0.1)
0.5	0.25pF	500	5001	4001
1.0	0.25pF		5002	4002
1.5	0.25pF		5003	4003
2.2	0.25pF		5004	4004
2.7	0.50pF		5005	4005
3.0	0.25pF		5006	4006
3.3	0.25pF		5007	4007
3.6	0.25pF		5008	4008
3.9	0.25pF		5009	4009
4.3	0.25pF		5010	4010
4.7	0.25pF		5011	4011
5.1	0.25pF		5012	4012
5.6	0.25pF		5013	4013
6.2	0.25pF		5014	4014
6.8	0.25pF		5015	4015
7.5	0.25pF		5016	4016
8.2	0.25pF	0.3	5017	4017
9.1	0.25pF		5018	4018
10	0.25pF		5019	4019
11	0.25pF		5020	4020
	5%		5021	4021
	5%		5022	4022
	5%		5023	4023
	5%		5024	4024
	5%		5025	4025
	5%		5026	4026
	5%	0.7	5027	4027
	5%		5028	4028
	5%		5029	4029
	5%		5030	4030
	5%	0.3	5031	4031
	5%		5032	4032
	5%			
	5%			

Capacitance		Dissipation Factor (%)	Rated Voltage (volts, dc)	Part Number M23269/05-	
Value (pF)	Tolerance (±)			Grade 1 FRL = R(0.01)	Grade 2 FRL = P(0.1)
12	0.25pF	0.3	500	5033	4033
	5%			5034	4034
13	2%			5035	4035
	5%			5036	4036
15	2%			5037	4037
	5%			5038	4038
16	2%			5039	4039
	5%			5040	4040
18	2%			5041	4041
	5%			5042	4042
20	2%			5043	4043
	5%			5044	4044
22	2%			5045	4045
	5%			5046	4046
24	2%			5047	4047
	5%			5048	4048
27	1%	0.1		5049	4049
	2%			5050	4050
	5%			5051	4051
30	1%			5052	4052
	2%			5053	4053
	5%			5054	4054
33	1%			5055	4055
	2%			5056	4056
	5%			5057	4057
36	1%			5058	4058
	2%			5059	4059
	5%			5060	4060
39	1%			5061	4061
	2%			5062	4062
	5%			5063	4063
43	1%			5064	4064

M23269/05, STYLE CYR13 (continued)

Fixed, Glass Dielectric, Established Reliability

Capacitance		Rated Voltage (volts, dc)	Dissipation Factor (%)	Part Number M23269/05-	
Value (pF)	Tolerance (± %)			Grade 1 FRL = R(0.01)	Grade 2 FRL = F(0.1)
43	2 5	500	0.1	5065	4065
				5066	4066
47	1 2 5			5067	4067
				5068	4068
				5069	4069
51	1 2 5			5070	4070
				5071	4071
				5072	4072
56	1 2 5			5073	4073
				5074	4074
				5075	4075
62	1 2 5			5076	4076
				5077	4077
				5078	4078
68	1 2 5			5079	4079
				5080	4080
				5081	4081
75	1 2 5			5082	4082
				5083	4083
				5084	4084
82	1 2 5			5085	4085
				5086	4086
				5087	4087
91	1 2 5			5088	4088
				5089	4089
				5090	4090
100	1 2 5			5091	4091
				5092	4092
				5093	4093
110	1 2			5094	4094
				5095	4095

Capacitance		Rated Voltage (volts, dc)	Dissipation Factor (%)	Part Number M23269/05-	
Value (pF)	Tolerance (± %)			Grade 1 FRL = R(0.01)	Grade 2 FRL = P(0.1)
110	5	500	0.1	5096	4096
				5097	4097
120	1 2 5			5098	4098
				5099	4099
130	1 2 5			5100	4100
				5101	4101
				5102	4102
150	1 2 5			5103	4103
				5104	4104
				5105	4105
160	1 2 5			5106	4106
				5107	4107
				5108	4108
180	1 2 5			5109	4109
				5110	4110
				5111	4111
200	1 2 5	300	0.1	5112	4112
				5113	4113
				5114	4114
220	1 2 5			5115	4115
				5116	4116
				5117	4117
240	1 2 5			5118	4118
				5119	4119
				5120	4120
270	1 2 5			5121	4121
				5122	4122
				5123	4123
300	1 2 5			5124	4124
				5125	4125
				5126	4126

M23269/09, STYLE CYR41
Fixed, Glass Dielectric, Established Reliability

Capacitance			Dissipation Factor (%)	Rated Voltage (volts, dc)	Part Number M23269/09-Grade 1 & Grade 2 FRL = P(0.1)													
Value (pF)	Tolerance (±)	Capacitance			Capacitance													
					V _{Value} (pF)	Tolerance (± %)												
0.5	0.25pF	0.5	100	0.1	82	1												
	0.25pF				2													
	0.25pF				5													
	0.25pF				1													
	0.25pF				2													
	0.25pF				5													
1	0.25pF	0.5			100	0.1	100	1										
	0.25pF						2											
	0.25pF						5											
	0.25pF						1											
	0.25pF						2											
	0.25pF						5											
10	0.25pF	5%					100	0.1	120	1								
	0.25pF								2									
	0.25pF								5									
	0.25pF								1									
	0.25pF								2									
	0.25pF								5									
12	0.25pF	5%							100	0.1	150	1						
	0.25pF										2							
	0.25pF										5							
	0.25pF										1							
	0.25pF										2							
	0.25pF										5							
15	0.25pF	2%									100	0.1	180	1				
	0.25pF												2					
	0.25pF												5					
	0.25pF												1					
	0.25pF												2					
	0.25pF												5					
18	0.25pF	5%											100	0.1	220	1		
	0.25pF														2			
	0.25pF														5			
	0.25pF														1			
	0.25pF														2			
	0.25pF														5			
22	0.25pF	2%													100	0.1	270	1
	0.25pF																2	
	0.25pF																5	
	0.25pF																1	
	0.25pF																2	
	0.25pF																5	
27	0.25pF	1%	100	0.1													330	1
	0.25pF																2	
	0.25pF																5	
	0.25pF																1	
	0.25pF																2	
	0.25pF																5	
33	0.25pF	1%			100	0.1											390	1
	0.25pF																2	
	0.25pF																5	
	0.25pF																1	
	0.25pF																2	
	0.25pF																5	
39	0.25pF	1%					100	0.1									470	1
	0.25pF																2	
	0.25pF																5	
	0.25pF																1	
	0.25pF																2	
	0.25pF																5	
47	0.25pF	1%							100	0.1							560	1
	0.25pF																2	
	0.25pF																5	
	0.25pF																1	
	0.25pF																2	
	0.25pF																5	
56	0.25pF	1%									100	0.1					680	1
	0.25pF																2	
	0.25pF																5	
	0.25pF																1	
	0.25pF																2	
	0.25pF																5	
68	0.25pF	1%											100	0.1			820	1
	0.25pF																2	
	0.25pF																5	
	0.25pF																1	
	0.25pF																2	
	0.25pF																5	

Capacitance			Dissipation Factor (%)	Rated Voltage (volts, dc)	Part Number M23269/09-Grade 1 & Grade 2 FRL = P(0.1)													
Value (pF)	Tolerance (±)	Capacitance			Capacitance													
					V _{Value} (pF)	Tolerance (± %)												
0.5	0.25pF	0.5	100	0.1	82	1												
	0.25pF				2													
	0.25pF				5													
	0.25pF				1													
	0.25pF				2													
	0.25pF				5													
1	0.25pF	5%			100	0.1	100	1										
	0.25pF						2											
	0.25pF						5											
	0.25pF						1											
	0.25pF						2											
	0.25pF						5											
10	0.25pF	5%					100	0.1	120	1								
	0.25pF								2									
	0.25pF								5									
	0.25pF								1									
	0.25pF								2									
	0.25pF								5									
12	0.25pF	5%							100	0.1	150	1						
	0.25pF										2							
	0.25pF										5							
	0.25pF										1							
	0.25pF										2							
	0.25pF										5							
15	0.25pF	2%									100	0.1	180	1				
	0.25pF												2					
	0.25pF												5					
	0.25pF												1					
	0.25pF												2					
	0.25pF												5					
18	0.25pF	5%											100	0.1	220	1		
	0.25pF														2			
	0.25pF														5			
	0.25pF														1			
	0.25pF														2			
	0.25pF														5			
22	0.25pF	2%													100	0.1	270	1
	0.25pF																2	
	0.25pF																5	
	0.25pF																1	
	0.25pF																2	
	0.25pF																5	
27	0.25pF	1%	100	0.1													330	1
	0.25pF																2	
	0.25pF																5	
	0.25pF																1	
	0.25pF																2	
	0.25pF																5	
33	0.25pF	1%			100	0.1											390	1
	0.25pF																2	
	0.25pF																5	
	0.25pF																1	
	0.25pF																2	
	0.25pF																5	
39	0.25pF	1%					100	0.1									470	1
	0.25pF																2	
	0.25pF																5	
	0.25pF																1	
	0.25pF																2	
	0.25pF																5	
47	0.25pF	1%							100	0.1							560	1
	0.25pF																2	
	0.25pF																5	
	0.25pF																1	
	0.25pF																2	
	0.25pF																5	
56	0.25pF	1%									100	0.1					680	1
	0.25pF																2	
	0.25pF																5	
	0.25pF																1	
	0.25pF																2	
	0.25pF																5	
68	0.25pF	1%											100	0.1			820	1
	0.25pF																2	
	0.25pF																5	
	0.25pF																1	
	0.25pF																2	
	0.25pF																5	

M23269/09, STYLE CYR42
Fixed, Glass Dielectric, Established Reliability

Capacitance			Dissipation Factor (%)	Rated Voltage (volts, dc)	Part Number M23269/09-Grade 1 & Grade 2 FRL = P(0.1)			
Value (pF)	Tolerance (±)	Value (pF)			Tolerance (± %)			
0.5	0.25pF	0.7	0.1	500	47	1	4101	4134
1.5	0.25pF				4102	4135		
2.7	0.25pF				4103	4136		
3.3	0.25pF				4104	4137		
3.9	0.25pF				4105	4138		
4.7	0.25pF				4106	4139		
5.6	0.25pF	0.3		300	68	1	4140	4149
6.8	0.25pF				4107	4150		
	5%				4108	4151		
8.2	0.25pF				4109	4152		
	5%				4110	4153		
10	0.25pF				4111	4154		
	5%	4112		4155				
12	0.25pF	0.1		100	100	1	4156	4164
	5%				4113	4165		
	5%				4114	4166		
	5%				4115	4167		
15	0.25pF				4116	4168		
	2%				4117	4169		
	5%	4118		4170				
18	0.25pF	0.1		50	120	1	4171	4179
	2%				4119	4180		
	5%				4120	4181		
22	0.25pF				4121	4182		
	2%				4122	4183		
	5%				4123	4184		
27	1%	0.1		50	150	1	4185	4193
	2%				4124	4194		
	5%				4125	4195		
22	0.25pF				4126	4196		
	2%				4127	4197		
	5%				4128	4198		
27	1%	0.1		50	220	1	4199	4207
	2%		4129		4208			
	5%		4130		4209			
33	1%		4131		4210			
	2%		4132		4211			
	5%		4133		4212			
39	1%	0.1	50	300	1	4213	4221	
	2%			4214	4222			
	5%			4215	4223			

M23269/09, STYLE CYR43
Fixed, Glass Dielectric, Established Reliability

Capacitance		Rated Voltage (volts, dc)	Part Number M23269/09-	
Value (pF)	Tolerance (± %)		Grade 1 & Grade 2 FRL = P(0.1)	
330	1	300	4301	
	2		4302	
	5		4303	
390	1		4304	
	2		4305	
	5		4306	
470	1	100	4307	
	2		4308	
	5		4309	
560	1		4310	
	2		4311	
	5		4312	
680	1		4313	
	2		4314	
	5		4315	

Capacitance		Rated Voltage (volts, dc)	Part Number M23269/09-	
Value (pF)	Tolerance (± %)		Grade 1 & Grade 2 FRL = P(0.1)	
820	1	50	4316	
	2		4317	
	5		4318	
1000	1		4319	
	2		4320	
	5		4321	
1200	1		4322	
	2		4323	
	5		4324	

M23269/10, STYLE CYR51

Fixed, Glass Dielectric, Established Reliability

Capacitance		Dissipation Factor (%)	Rated Voltage (volts, dc)	Part Number M23269/10- Grade 1 & Grade 2 FRL = M(1.0)
Value (pF)	Tolerance (±)			
1	0.25pF	0.2	300	3001
1.5	0.25pF			3002
2.2	0.25pF			3003
2.7	0.25pF			3004
3.0	0.25pF			3005
3.3	0.25pF			3006
3.6	0.25pF			3007
3.9	0.25pF			3008
4.3	0.25pF			3009
4.7	0.25pF			3010
5.1	0.25pF			3011
	5%			3012
5.6	0.25pF			3013
	1%			3014
6.2	0.25pF			3015
	5%			3016
6.8	0.25pF			3017
	5%			3018
7.5	0.25pF			3019
	5%			3020
8.2	0.25pF			3021
	5%			3022
9.1	0.25pF			3023
	5%			3024
10	0.25pF			3025
	5%			3026
11	0.25pF			3027
	5%			3028
12	0.25pF			3029
	5%			3030
13	0.25pF			3031
	2%			3032
	5%			3033
15	0.25pF			3034
	2%			3035
	5%			3036
16	0.25pF			3037
	2%			3038

Capacitance		Dissipation Factor (%)	Rated Voltage (volts, dc)	Part Number M23269/10- Grade 1 & Grade 2 FRL = M(1.0)
Value (pF)	Tolerance (±)			
16	5%	0.2	300	3039
	0.25pF			3040
18	2%			3041
	5%			3042
20	0.25pF			3043
	2%			3044
	5%			3045
22	0.25pF			3046
	2%			3047
	5%			3048
24	0.25pF			3049
	2%			3050
	5%			3051
27	1%			3052
	2%			3053
	5%			3054
30	1%			3055
	2%			3056
	5%			3057
33	1%			3058
	2%			3059
	5%			3060
36	1%			3061
	2%			3062
	5%			3063
39	1%			3064
	2%			3065
	5%			3066
43	1%			3067
	2%			3068
	5%			3069
47	1%			3070
	2%			3071
	5%			3072
51	1%			3073
	2%			3074
	5%			3075
56	1%			3076

M23269/10, STYLE CYR51 (continued)
Fixed, Glass Dielectric, Established Reliability

Capacitance		Dissipation Factor (%)	Rated Voltage (volts, dc)	Part Number M23269/10-Grade 1 & Grade 2 FRL = M(1.0)
Value (pF)	Tolerance (± %)			
56	2	0.2	300	3077
	5			3078
62	1			3079
	5			3080
68	1			3081
	2			3082
75	5			3083
	1			3084
82	2			3085
	5			3086
91	1			3087
	2			3088
100	5			3089
	1			3090
110	2			3091
	5			3092
120	1			3093
	2			3094
130	5			3095
	1			3096
150	2	3097		
	5	3098		
160	1	3099		
	2	3100		
180	5	3101		
	1	3102		
	2	3103		
	5	3104		
	1	3105		
	2	3106		
	5	3107		
	1	3108		
	2	3109		
	5	3110		
	1	3111		
	2	3112		
		3113		

Capacitance		Dissipation Factor (%)	Rated Voltage (volts, dc)	Part Number M23269/10- Grade 1 & Grade 2 FRL = M(1.0)
Value (pF)	Tolerance (± %)			
180	5	0.1	300	3114
				3115
200	1 2 5			3116
				3117
220	1 2 5			3118
				3119
				3120
240	1 2 5			3121
				3122
				3123
270	1 2 5			3124
				3125
				3126
300	1 2 5			3127
				3128
				3129
330	1 2 5			3130
				3131
				3132
360	1 2 5			3133
				3134
				3135
390	1 2 5			3136
				3137
				3138
430	1 2 5			3139
				3140
				3141
470	1 2 5			3142
				3143
				3144
510	1 2 5			3145
				3146
				3147
560	1 2 5			3148
				3149
				3150

M23269/10, STYLE CYR52

Fixed, Glass Dielectric, Established Reliability

Capacitance		Rated Voltage (volts, dc)	Part Number M23269/10- Grade 1 & Grade 2 FRL = M(1.0)
Value (pF)	Tolerance (± %)		
620	1	300	3201
	2		3202
	5		3203
680	1		3204
	2		3205
	5		3206
750	1		3207
	2		3208
	5		3209
820	1		3210
	2		3211
	5		3212
910	1		3213
	2		3214
	5		3215
1000	1		3216
	2		3217
	5		3218

M23269/10, STYLE CYR53

Fixed, Glass Dielectric, Established Reliability

Capacitance		Rated Voltage (volts, dc)	Part Number M23269/10- Grade 1 & Grade 2 FRL = M(1.0)
Value (pF)	Tolerance (± %)		
1100	1	300	3301
	2		3302
	5		3303
1200	1		3304
	2		3305
	5		3306
1300	1		3307
	2		3308
	5		3309
1500	1		3310
	2		3311
	5		3312
1600	1		3313
	2		3314
	5		3315
1800	1		3316
	2		3317
	5		3318
2000	1		3319
	2		3320
	5		3321
2200	1		3322
	2		3323
	5		3324
2400	1		3325
	2		3326
	5		3327

Index of Preferred Connectors

Style	Description	Specification	Refer To
G311P10	Power Connectors, Solder Contacts (sub-miniature)	GSFC S-311-P-10	Page 02-2
311P409 and 311P405	Power Connectors, Removable Contacts (sub-miniature)	GSFC S-311-P-4/9 and 4/5	Page 02-3
311P407	Power connectors, Crimp Removable Contacts (sub-miniature High Density)	GSFC S311P-4/7	Page 02-4
40M38277	High Density, Miniature	MSFC	MIL-STD-975
40M39569	Miniature (200°C)	MSFC	MIL-STD-975
MS3450	Threaded coupling, AN Type	MIL-C-5015	MIL-STD-975
M24308	Rectangular, Miniature, Solder Contact	MIL-C-24308	MIL-STD-975
M24308	Rectangular, Miniature, Crimp Removable contacts, and High Density Miniature	MIL-C-24308	MIL-STD-975
MS3470	Circular, Miniature, Quick Disconnect	MIL-C-26482	MIL-STD-975
MS27466	Miniature, High Density, Quick Disconnect	MIL-C-38999	MIL-STD-975
MS27472	Miniature, High Density, Quick Disconnect	MIL-C-38999	MIL-STD-975
M39012	Coaxial, Radio Frequency	MIL-C-39012	MIL-STD-975
MS17343	Circular, Heavy Duty, Quick Disconnect	MIL-C-22992	MIL-STD-975

POWER CONNECTORS **Rack and Panel, Sub-Miniature, Solder Contacts**

Construction	Contacts		For Use With Wire Size	Grade 1			Grade 2			Remarks
	Qty.	Type		GSFC Type ¹	Specification GSFC	Manufacturer	MIL Part Number ²	Specification ³	Manufacturer	
Receptacle, Rectangular	9	Socket	AWG #20 max.	G311P10B-1S-C-15	S-311-P-10	ITT Cannon Electric	M24308/1-1	MIL-C-24308	QPL-24308	All GSFC type connectors: "15" in type indicates 0.154 inch (0.39 mm) dia. mounting hole, 0.120 inch (0.31 mm) dia. is available, indicate by "12."
	15	Socket		G311P103-2S-C-15			M24308/1-2			
	25	Socket		G311P108-3S-C-15			M24308/1-3			
	37	Socket		G311P108-4S-C-15			M24308/1-4			
	50	Socket		G311P108-5S-C-15			M24308/1-5			
Plug, Rectangular	9	Pin		G311P10-1P-C-15	S-311-P-10	TRW Cinch Connectors	M24308/3-1	MIL-C-24308	QPL-24308	Military specification connectors: 0.120 inch dia. mounting hole.
	15	Pin		G311P10-2P-C-15			M24308/3-2			
	25	Pin		G311P10-3P-C-15			M24308/3-3			
	37	Pin		G311P10-4P-C-15			M24308/3-4			
	50	Pin		G311P10-5P-C-15			M24308/3-5			

NOTES:

1. C = 20 gamma residual magnetism level; other levels B = 200 and D = 2 gamma are available.
2. Residual magnetism level is not specified. Not recommended for Space Flight use, and should be used for ground support application only. For grade 2 flight application use a grade 1 part.
3. The military specification prescribes relaxed quality assurance provisions when compared with GSFC S-311-P-10 (see Grade 1 Parts). For example, the GSFC specification requires 100% screening, whereas the military specification testing is on a sample basis only.

POWER CONNECTORS **Rack and Panel, Sub-Minature, Crimp Removable Contacts**

Construction	Contacts		For Use With Wire Size	Grade 1				Grade 2				Remarks	
	Qty.	Type		Shell		Contact	Manufacturer	MIL Part Number ² M24308	Specification ³	Manufacturer			
				GSFC Type ¹ 311P409	Specification GSFC						GSFC Type		Specification GSFC
Receptacle, Rectangular	9	Socket	AWG # 20- 22- 24	-1S-B-15	S-311-P-4/9	S-311-P-4/10	AMP, Inc. ITT Cannon Electric	/2-1 /2-2 /2-3 /2-4 /2-5	MIL-C-24308	QPL 24308	All GSFC type connectors "-15" type indicates 0.154 inch (0.39 mm) dia. mounting hole. 0.120 inch (0.31 mm) dia. is available, indicate by "-12." Military specification connectors: 0.120 inch dia. mounting hole.		
	15			-2S-B-15									
	25			-3S-B-15									
	37			-4S-B-15									
	50			-5S-B-15									
Plug, Rectangular	9	Pin		-1P-B-15		G10P1	TRW Cinch Connectors	/4-1 /4-2 /4-3 /4-4 /4-5					
	15			-2P-B-15									
	25			-3P-B-15									
	37			-4P-B-15									
	50			-5P-B-15									

NOTES:

1. B - 200 gamma residual magnetism level. Other levels are available when required by the application and may be selected as shown below.

Residual Magnetism (gamma)	Shell		Contacts	
	GSFC Type	Specification GSFC	Pin	Socket
20	311P405XX-C-XX	S-311-P-4/5	GPP1	GPS1
2	311P405XX-D-XX			

2. Residual magnetism level is not specified. Not recommended for Space Flight use, and should be used for ground support application only. For grade 2 flight application use a grade 1 part.

3. The military specification prescribes relaxed quality assurance provisions when compared with GSFC S-311-P-4 (see Grade 1 Parts). For example, the GSFC specification requires 100% screening, whereas the military specification requires testing is on a sample basis only.

POWER CONNECTORS **Rack and Panel, Sub-Miniature, High Density, Crimp Removable Contacts**

Construction	Contacts		For Use With Wire Size	Grade 1				Grade 2			Remarks	
	Qty.	Type		Shell		Contact		Manufacturer	MIL Part Number ² M24308	Specification ³		Manufacturer
				GSFC Type ¹ 311P407	Specification GSFC	GSFC Type	Specification GSFC					
Receptacle, Rectangular	15	Socket	AWG # 22-28	-1S-B-15	S-311-P-4/7	G08S1	Amp, Inc.	/2-11 /2-12 /2-13 /2-14 /2-15 /2-16	MIL-C-24308	QPL-24308	All GSFC type connectors: "-15" type indicates 0.154 inch (0.39 mm) dia. mounting hole, 0.120 inch (0.31 mm) dia. is available, indicate by "-12." Military specification connectors: 0.120 inch dia. mounting hole.	
	26											
	44											
	62											
	78											
	104											
Plug, Rectangular	15	Pin	24-28	-1P-B-15	S-311-P-4/8	G08P1	Amp, Inc.	/4-11 /4-12 /4-13 /4-14 /4-15 /4-16	MIL-C-24308	QPL-24308	Military specification connectors: 0.120 inch dia. mounting hole.	
	26											
	44											
	62											
	78											
	104											

NOTES:

1. B = 200 gamma residual magnetism level. No other residual magnetism levels are available for this type of connector.
2. Residual magnetism level is not specified. Not recommended for Space Flight use, and should be used for ground support application only. For grade 2 flight application use a grade 1 part.
3. The military specification prescribes relaxed quality assurance provisions when compared with GSFC S-311-P-4 (see Grade 1 Parts). For example, the GSFC specification requires 100% screening, whereas the military specification requires testing is on a sample basis only.

Index of Preferred Filters

Style	Description	Specification	Refer To
M18327/27-001	Band Pass	MIL-F-18327	MIL-STD-975
M18327/46-001	Band Pass	MIL-F-18327	MIL-STD-975
M18327/46-002	Band Pass	MIL-F-18327	MIL-STD-975
S-311-P-5/3	Electromagnetic Interference Suppression	S-311-P-5/3 (GSFC)	Page 03-2
S-311-P-5/4	Electromagnetic Interference Suppression	S-311-P-5/4 (GSFC)	Page 03-2

FILTERS **Electromagnetic Interference (EMI) Suppressors**

Description	Voltage Rating (VDC) (@ 85°C)	Insertion Loss (25°C, No-Load)		GSFC Specification	Grade 1 Grade 2		Remarks
		Freq. Range	DB Range		Manufacturer & Part Type ¹		
L Section, Hermetically Sealed, Stud-Mounted	35	10 MHz thru 1 GHz 150 kHz	>64 db >25 db	S-311-P-5/3	Erie S-311-P-5/3		Inductor at threaded end. Similar to Erie 9200-530-0025
L Section, Hermetically Sealed, Stud-Mounted	35	10 MHz thru 1 GHz 150 kHz	>64 db >25 db	S-311-P-5/4	Erie S-311-P-5/4		Capacitor at threaded end. Similar to Erie 9215-530-0025

NOTES:
1. In addition to the requirements of the specification, parts should be procured with a radiographic inspection consisting of two views perpendicular to each other and to the major axis of the device.

FILTERS **Band Pass**

The MIL-F-18327 band pass filters listed in MIL-STD-975 are not recommended for flight or critical ground applications. They should be used only in non-critical ground applications. Consult the GSFC Parts Branch (Code 311) for assistance in the selection and testing of band pass filters.

[illegible]

1. GSFC recommends additional screening for Grade 1 applications per section C-4 Table 04.
2. GSFC recommends additional screening for Grade 2 applications per section C-4 Table 04.
3. Refer to Appendix B, Table 04 for Fuse Derating outline for all applications.
4. GSFC recommends the use of redundant circuits for critical flight applications.
5. No Grade 2 part exists at the present time. Use the listed Grade 1 part.

Index of Preferred Inductors

MIL Style	Description	Specification	Refer To
MIL-T-27/146	Audio Frequency, High Q	MIL-T-27	MIL-STD-975
MIL-T-27/164	Audio Frequency, High Q	MIL-T-27	MIL-STD-975
MIL-T-27/241	Audio Frequency, High Q	MIL-T-27	MIL-STD-975
MS21367	Coil, Fixed, Radio Frequency, Micro Miniature, Shielded, Iron Core	MIL-C-15305	MIL-STD-975
MS21368	Coil, Fixed, Radio Frequency, Micro Miniature, Shielded, Iron Core	MIL-C-15305	MIL-STD-97E
MS21369	Coil, Fixed, Radio Frequency, Micro Miniature, Shielded, Iron Core	MIL-C-15305	MIL-STD-975
MS90538	Coil, Fixed, Radio Frequency, Subminiature, Iron Core	MIL-C-15305	MIL-STD-975
MIL-C-39010/01	Coil, Fixed, Radio Frequency, Micro Miniature, Shielded, Phenolic Core	MIL-C-39010	MIL-STD-975
MIL-C-39010/02	Coil, Fixed, Radio Frequency, Micro Miniature, Shielded, Iron Core	MIL-C-39010	MIL-STD-975
MIL-C-39010/03	Coil, Fixed, Radio Frequency, Micro Miniature, Shielded, Ferrite Core	MIL-C-39010	MIL-STD-975
MIL-C-39010/06	Coil, Fixed, Radio Frequency, Micro Miniature, Phenolic Core	MIL-C-39010	MIL-STD-975
MIL-C-39010/07	Coil, Fixed, Radio Frequency, Micro Miniature, Powdered Iron Core	MIL-C-39010	MIL-STD-975

Index of Preferred Relays

Style	Description	Specification	Refer To
P2/33	Latching	GSFC S311 P2(06)/33	Page 06-3
P2/37	Latching	GSFC S311 P2(06)/37	Page 06-3
P2/39	Nonlatching	GSFC S311 P2(06)/39	Page 06-2
P2/42	Nonlatching	GSFC S311 P2(06)/42	Page 06-2
P2/47	Nonlatching	GSFC S311 P2(06)/47	Page 06-2
P2/48	Nonlatching	GSFC S311 P2(06)/48	Page 06-2
P2/50	Latching	GSFC S311 P2(06)/50	Page 06-3
P2(06)/19	Nonlatching	GSFC S311 P2(06)/19	Page 06-2
P2(06)/23	Nonlatching	GSFC S311 P2(06)/23	Page 06-2
P2(06)/27	Latching	GSFC S311 P2(06)/27	Page 06-3
P2(06)/35	Latching	GSFC S311 P2(06)/35	Page 06-3
M39016/9	Nonlatching	MIL-R-39016/9	Page 06-2 ¹
M39016/11	Nonlatching	MIL-R-39016/11	MIL-STD-975 ¹
M39016/12	Latching	MIL-R-39016/12	Page 06-3 ¹
M39016/13	Nonlatching	MIL-R-39016/13	Page 06-2
M39016/14	Nonlatching	MIL-R-39016/14	Page 06-2
M39016/15	Nonlatching	MIL-R-39016/15	Page 06-2 ¹
M39016/20	Nonlatching	MIL-R-39016/20	MIL-STD-975 ¹
M39016/29	Latching	MIL-R-39016/29	Page 06-3
M39016/31	Latching	MIL-R-39016/31	Page 06-3
MS27400	Nonlatching	MIL-R-6106	Page 06-2
MS27401	Nonlatching	MIL-R-6106	Page 06-2
MS27742	Latching	MIL-R-6106	Page 06-3

NOTE:

1. These styles are listed in MIL-STD-975. GSFC considers these parts to be suitable only for Grade 2 ground support applications.

Relays, Nonlatching

Electrical Data					Mechanical Data			Grade 1 ¹				Grade 2 ²				Remarks
Contact Rating at 28 vdc Resistive ³ (amps)	Coil Voltage		Nominal dc Coil Resistance (ohms)	Contact Form ⁴	Package Type	Terminal Type	GSFC Part Number	Specification GSFC-S-311-P-2(06)	Mfr.	MIL Part Number	Specification ⁵	Mfr.				
	Nominal (vdc)	Pull-in (max) (vdc)														
1.0 ⁶	26.5	18.0	1560	2 Form C (2PDT)	TO-5 Can	Wire Leads	P2/39-01	/39	Teledyne	M39016/9-006P	MIL-R-39016/9	QPL-39016				
	18.0	13.5	880				P2/39-02			M39016/9-005P						
	12.0	9.0	390				P2/39-03			M39016/9-004P						
	9.0	6.8	220				P2/39-04			M39016/9-003P						
1.0 ⁶	6.0	4.5	98	2 Form C (2PDT)	TO-5 Can	Wire Leads	P2/39-05	/48	Teledyne	M39016/9-002P	MIL-R-39016/15	QPL-39016	Coil Transient Suppression			
	26.5	18.0	1560				P-2/48-01			M39016/15-005P						
	18.0	13.5	880				P-2/48-02			M39016/15-004P						
	12.0	9.0	390				P-2/48-03			M39016/15-003P						
1.0 ⁶	9.0	6.8	220	4 Form C (4PDT)	Low ⁷ Profile	Pins	P-2/48-04	/42	GE	M39016/15-002P	MIL-R-39016/14					
	6.0	4.5	98				P-2/48-05			M39016/15-001P						
	26.5	13.5	720				P-2/42-03			M39016/14-002M						
	12.0	5.4	115				P-2/42-02			M39016/14-007M						
2.0 ⁶	6.0	2.7	28	2 Form C (2PDT)	1/2 Crystal Can	Solder Lugs	P-2/42-01	/47	GE	M39016/14-005M	MIL-R-39016/13					
	26.5	13.5	1350				P-2/47-01			M39016/13-060M						
	12.0	5.4	210				P-2/47-02			M39016/13-065M						
	6.0	2.7	56				P-2/47-03			M39016/13-064M						
10.0	28.0	18.0	320	2 Form C (2PDT)	Crystal Can	Solder Lugs	P-2(06)/23-01	/23	QPL-6106 (MS27401)	MS27401-1	MIL-R-6106	QPL-6106				
							P-2(06)/23-02			MS27401-2						
							P-2(06)/19-01			MS27400-1						
							P-2(06)/19-02			MS27400-2						
10.0	28.0	18.0	290	4 Form C (4PDT)	One Inch Cube	Solder Lugs	P-2(06)/19-01	/19	QPL-6106 (MS27400)	MS27400-1	MIL-R-6106	QPL-6106				
							P-2(06)/19-02			MS27400-2						
							P-2(06)/19-01			MS27400-1						
							P-2(06)/19-02			MS27400-2						

NOTES:

1. Parts for flight use must be obtained with unpainted enclosures.
2. For ground support only. For flight applications, use Grade 1 Part.
3. For contact ratings for other types of loads (inductive, lamp, motor), contact the Passive Devices Section.
4. Refer to MIL-R-39016 or the NARM Engineers Relay Handbook for definitions of forms (example: form C = single break, double throw, transfer, break before make).
5. These military specifications prescribe relaxed quality assurance provisions when compared with GSFC-S-311-P-2(06), (see Grade 1 parts). For example, the GSFC specifications requires 100% pre-cap visual inspection, whereas the military specifications do not.
6. Contacts also rated for low level applications.
7. 15.5 mm x 15.5 mm x 8.1 mm high (.610" x .610" x .320").

Relays, Latching

Electrical Data					Mechanical Data			Grade 1 ¹				Grade 2 ²			Remarks
Contact Rating at 28 vdc Resistive ³ (amps)	Coil Voltage		Nominal dc Coil Resistance (ohms)	Contact Form ⁴	Package Type	Terminal Type	GSFC Part Number	Specification GSFC-S-311-P-2(06)	Mfr.	MIL Part Number	Specification ⁵	Mfr.			
	Nominal (vdc)	Pull-in (max) (vdc)													
1.0 ⁶	26.5	18.0	2000	2 Form C (2PDT)	TO-5 Can	Wire Leads	P2/33-01	/33	Teledyne	M39016/12-018P	MIL-R-39016/12	QPL-39016			
	18.0	13.5	1130				P2/33-02			M39016/12-017P					
	12.0	9.0	500				P2/33-03			M39016/12-016P					
	9.0	6.8	280				P2/33-04			M39016/12-015P					
	6.0	4.5	120				P2/33-05			M39016/12-014P					
1.0 ⁶	26.5	18.0	2000	2 Form C (2PDT)	TO-5 Can	Wire Leads	P-2/37-01	/37	Teledyne	M39016/29-018P	MIL-R-39016/29	QPL-39016	Coil Transient Suppression		
	18.0	13.5	1130				P-2/37-02			M39016/29-017P					
	12.0	9.0	500				P-2/37-03			M39016/29-016P					
	9.0	6.8	280				P-2/37-04			M39016/29-015P					
	6.0	4.5	120				P-2/37-05			M39016/29-014P					
2.0 ⁶	24.0	18.0	1000	2 Form C (2PDT)	1/2 Crystal Can	Solder Hook	P2/50-01	150	Potter and Brumfield (AMF)	8					
	12.0	6.8	250				P2/50-02								
	24.0	18.0	1000				P2/50-03								
	12.0	6.8	250				P2/50-04								
	24.0	18.0	1000				P2/50-05								
	12.0	6.8	250	P2/50-06											
2.0 ⁶	26.5	13.5	975	4 Form C (4PDT)	Low ⁷ Profile	Pins	P-2(06)/27-01	/27	GE	M39016/31-003M	MIL-R-39016/31				
25.0	28.0	18.0	450	3 Form C (3PDT)	One Inch Cube	Solder Lugs	P-2(06)/35-01	/35	QPL-6106 (MS27742)	MS27742-1	MIL-R-6106	QPL-6106			
							P-2(06)/35-02			MS27742-2					

NOTES:

NOTES:

1. Parts for flight use must be obtained with unpainted enclosures.
2. For ground support only. For flight applications, use Grade 1 Part.
3. For contact ratings for other types of loads (inductive, capacitive, lamp, motor), contact the Passive Devices Section.
4. Refer to MIL-R-39016 or the NARM Engineers Relay Handbook for definitions of forms (example: form C = single break, double throw, transfer, break before make).
5. These military specifications prescribe relaxed quality assurance provisions when compared with GSFC-S-311-P-2(06), (see Grade 1 parts). For example, the GSFC specification requires 100% pre-cap visual inspection, whereas the military specifications do not.
6. Contracts also rated for low level applications.
7. 15.5mm x 15.5mm x 8.1mm high (.610" x .610" x .320").
8. Use Grade 1 parts (no other versions are available).

Index of Preferred Resistors

MIL Style	Description	Specification	Refer To
RBR	Wire wound, Precision, Accurate	MIL-R-39005	MIL-STD-975
RWR	Wire wound, Power	MIL-R-39007	MIL-STD-975
RCR	Composition	MIL-R-39008	MIL-STD-975
RER	Wire wound, Power, Chassis Mounted Non-Inductive and Inductive winding	MIL-R-39009	MIL-STD-975
RLR	Film, General Purpose	MIL-R-39017	MIL-STD-975
RTR	Wire wound, Variable	MIL-R-39015	MIL-STD-975
RJR	Non-wire wound, variable	MIL-R-39035	MIL-STD-975
RN(X) ¹	Film, High Stability	MIL-R-55182	MIL-STD-975
RZO	Fixed Film Networks	MIL-R-83401	MIL-STD-975

NOTE:

1. GSFC does not consider type "C" terminal material to be readily weldable, and recommends using type "N" in welding applications. Type "C" and "R" may be used in soldering applications. Styles 75 and 90 are available only with type "C" terminal material.

Index of Preferred Diodes

Grade 1 ¹	Type Designation JANS	Grade 2 Type Designation JANTXV2	Function	Refer To
			Type No.	
			Small Signal	
	1N645-1			
	1N647-1			
	1N649-1			
	1N746A-1		Zener Voltage Regulator	MIL-STD-975
	1N759A-1			
	1N821-1			Page 08-3
	1N823-1			MIL-STD-975
	1N825-1			Page 08-3
	1N827-1		Voltage Reference	
	1N829-1			MIL-STD-975
	1N835B			Page 08-3
	1N837B			
	1N940B		Zener Voltage Reference	MIL-STD-975
	1N941B			
	1N943B			
	1N944B		Voltage Reference	Page 08-3
	1N945B			
	1N962B			
	1N962B-1		Zener Voltage Regulator	
	1N978B-1			MIL-STD-975
	3TX1N1202A		Power Rectifier	
	1N2970B			
	1N3051B		Zener Voltage Regulator	
	1N3595		Switching	Page 08-2
	1N3600			
	1N3821A		Voltage Regulator	
	1N3828A			
	1N3891		Fast Switching Power Rectifier	MIL-STD-975
	1N3893			
	1N4099		Voltage Regulator	
	1N4135			Page 08-4
	1N4148-1		Small Signal	
	1N4150-1		Switching	MIL-STD-975
	1N4153-1			Page 08-2

Grade 1 ¹	Type Designation JANS	Grade 2 Type Designation JANTXV2	Function	Refer To
			Type No.	
			Power	
	1N4245			Page 08-7
	1N4247			
	1N4249		Power	
	1N4306		Switching	Page 08-2
	1N4307			
	1N4370A-1		Voltage Regulator	MIL-STD-975
	1N4372A-1			
	1N4454-1		Switching	Page 08-2
	1N4460		Zener Voltage Regulator	
	1N4496			MIL-STD-975
	1N4531			
	1N4532		Switching	Page 08-2
	1N4465A			
	1N4569A		Voltage Reference	Page 08-3
	1N4570A			
	1N4574A		Zener Voltage Reference	MIL-STD-975
	1N4614			
	1N4627		Voltage Regulator	Page 08-5
	1N4942			
	1N4944			
	1N4946		Fast Switching Power Rectifier	Page 08-6
	1N4947			
	1N4948			
	1N4954		Voltage Regulator	
	1N4996			MIL-STD-975
	1N5139A			
	1N5148A		Voltage Variable Capacitor	Page 08-7
	1N5285			
	1N5314		Current Regulator	
	1N5415			
	1N5420		Fast Switching Power Rectifier	MIL-STD-975
	1N5550			
	1N5554		Power Rectifier	
	1N5614			

Grade 1 ¹	Type Designation JANS	Grade 2 Type Designation JANTXV2	Function	Refer To
			Type No.	
			Fast Switching Power Rectifier	
	1N5615			
	1N5616		Power Rectifier	
	1N5617		Fast Switching Power Rectifier	
	1N5618		Power Rectifier	
	1N5619		Fast Switching Power Rectifier	
	1N5620		Power Rectifier	
	1N5621		Fast Switching Power Rectifier	
	1N5622		Power Rectifier	
	1N5623		Fast Switching Power Rectifier	
	1N5629A			
	1N5665A		Zener Voltage Suppressor	MIL-STD-975
	1N5711			
	1N5712		Schottky Barrier Switching	
	3TX1N5719		PIN Switching	
	3TX1N5765		LED	
	1N5768			
	1N5770		Array	
	1N5772			
	1N5774			
	1N5814		Power Rectifier	
	1N5816			
	3TX1N5829		Schottky Barrier Rectifier	
	3TX1N5830			
	3TX1N5831			
	1N5907		Zener Voltage Suppressor	
	1N6073			Page 08-6
	1N6081		Fast Switching Power Rectifier	
	3TX1N6092			
	3TX1N6093			
	3TX1N6094		LED	
	1N6102-A			
	1N6173-A		Transient Voltage Suppressor	MIL-STD-975
	2N2322A			
	2N2324A			
	2N2326A		SCR	
	2N2328A			

NOTES:

1. When no Grade 1 diode is available, a Grade 2 diode may be upgraded for use in Grade 1 applications in accordance with Appendix A.
2. JANTXV diodes must be rescreened in accordance with the applicable TX detail specification of MIL-S-19500 for use in Grade 2 applications.
3. This device is not available as JANS or JANTXV and is considered to be a NON-STANDARD part by GSFC.

DIODES Switching, Silicon¹

Grade 1 ²	Grade 2	Specification MIL-S-19500	Manufacturer	Maximum Forward Voltage (Vdc)	Forward Current (mA dc)	Maximum Reverse Current (μ A dc)	Reverse Voltage (Vdc)	Reverse Recovery Time (t_{rr}) (nsec)	Capacitance (pF)	Case Dwg.	Remarks
Type Designation JANS	Type Designation JAN TXV3										
1N3595		/241	QPL-19500	0.88	50	0.001	125	3000	8.0	4	
1N3600		/231		0.86	50	0.10	50	4	2.5		
1N4150-1				0.86	50	0.10	50		2.5		
1N4153-1		/337		0.81	10	0.05	50		2.0		
1N4306		/278		0.81	10	5.0	75	4	2.0	4 lead flat pack ₅	Two matched discrete hermetically sealed diodes are encapsulated in a plastic module.
1N4307		/284		0.81	10	5.0	75		2.0	8 lead flat pack ₆	Four matched discrete hermetically sealed diodes are encapsulated in a plastic module.
1N4454-1		/144		1.0	10	0.1	50	4	2.0	DO35	
1N4531		/116		1.0	10	5.0	75	5	4.0	4	
1N4532		/144		1.0	10	0.1	50	4	2.0		

NOTES:

- See MIL-STD-975 for additional types.
- See Note 1 on Page 08-1.
- See Note 2 on Page 08-1.
- This case does not meet the dimensional criteria for any JEDEC outline. See MIL-S-19500 detail specification for case outline dimensions.
- 11.30 mm x 4.37 mm x 7.62 mm.
- 11.30 mm x 4.37 mm x 12.45 mm.

DIODES **Voltage Reference, Silicon¹**

Voltage Reference, Silicon ¹												
Grade 1 ²		Grade 2		Specification MIL-S-19500	Manufacturer	Reference Voltage (min/max) (Vdc)	Zener Current (mA _{dc}) @	Voltage Change (Vdc)	Temperature Range	Impedance (ohms) @	Zener Current (mA _{dc})	Case Dwg.
Type Designation JANS	Type Designation JANTXV3											
1N821-1				/159	OPL-19500	5.90/6.50	7.5	0.096	-55°C - 100°C	15	7.5	D07
1N825-1								0.019				
1N935B				/156		8.55/9.45		0.184	-55°C - 150°C	20		
1N941B								0.239				
1N943B				0.047		30						
1N944B				0.024								
1N945B				0.012								
1N4565A				0.100		200		0.5				
1N4566A				0.050								
1N4567A				0.020								
1N4568A				0.010								
1N4569A				0.005								

NOTES:

1. See MIL-STD-975 for additional types.

2. See Notes 1 and 3 for additional types.

NOTES:

1. See MIL-STD-975 for additional types.
2. See Note 1 on Page 08-1.
3. See Note 2 on Page 08-2.

DIODES (Page 1 of 2)
Voltage Regulator, Silicon¹

Grade 12	Grade 2	Specification MIL-S-19500	Manufacturer	Nominal Reference Voltage V _Z (V) @ I _Z (mA)	Max. Impedance Z _Z (Ohms)	Max. Diss. T _A = 25°C (W)	Voltage Temp. Coefficient (%/°C)	Max. Temp.	Case Dwg.	Remarks
Type Designation JANS	Type Designation JAV1TXV3	/435	OPL-19500	6.8	200	0.40	+0.060	175°C	D014	Low Noise Devices
1N4099	56			+0.065						
1N4100	51			+0.070						
1N4101	46			+0.075						
1N4102	44			200	+0.080					
1N4103	42									
1N4104	38									
1N4105	35									
1N4106	32			100	+0.085					
1N4107	29									
1N4108	27									
1N4109	25									
1N4110	24			150	+0.090					
1N4111	22									
1N4112	21									
1N4113	20									
1N4114	19									
1N4115	17									
1N4116	16									
1N4117	15			200	+0.095					
1N4118	14									
1N4119	14									
1N4120	13									
1N4121	12									
1N4122	11									
1N4123	9.8									
1N4124	8.9									
1N4125	8.1									
1N4126	7.5						250			
1N4127	6.7									
1N4128	6.4									
1N4129	6.1			400	+0.100					
1N4130	5.6									
1N4131	5.1									
1N4132	4.6			500	+0.100					
1N4133	4.4									
1N4134	4.2									
1N4135	3.8	700	+0.100							
	800									
	1000									
	1200									
	1500									

- NOTES:
1. See MIL-STD-975 for additional types.
 2. See Note 1 on Page 08-1.
 3. See Note 2 on Page 08-2.

DIODES (Page 2 of 2)
Voltage Regulator, Silicon¹

Grade 1 ²	Grade 2	Specification MIL-S-19500	Manufacturer	Nominal Reference Voltage V _Z (V) @ I _Z (mA)	Max. Impedance Z _Z (Ohms)	Max. Diss. T _A = 25°C (W)	Voltage Temp. Coefficient (%/°C)	Max. Temp.	Case Dwg.	Remarks
Type Designation JANS	Type Designation JANTXV3									
1N4614				1.8	1200					
1N4615				2.0	1250					
1N4616				2.2	1300					
1N4617				2.4	1400		-0.075			
1N4618				2.7	1500					
1N4619				3.0	1600					
1N4620				3.3	1650					
1N4621		/435	QPL-19500	3.6	1700	0.040	-0.065	175°C	D014	Low Noise Devices
1N4622				3.9	1650		-0.060			
1N4623				4.3	1600		-0.050			
1N4624				4.7	1550		-0.040/+0.020			
1N4625				5.1	1500		-0.045/+0.030			
1N4626				5.6	1400		-0.020/+0.040			
1N4627				6.2	1200		-0.010/+0.050			

NOTES:

1. See MIL-STD-975 for additional types.
2. See Note 1 on Page 08-1.
3. See Note 2 on Page 08-2.

DIODES
Power Rectifiers, Fast Switching, Silicon¹

Grade 1 ²	Grade 2	Specification MIL-S-19500	Manufacturer	I _O (Ade)	V _{RM} (wkg) [V (pk)]	Reverse Recovery Time (t _{rr}) (nsec)	Maximum Reverse Current (μAde)	Reverse Voltage (Vdc)	I _{FSM} (1/120 sec) (A pk)	Case Dwg.
1N3891		/304	OPL-19500	12	200	200	25	200	150	D04
1N4942					200	150		200		
1N4944					400	150		400	10	
1N4946		/359		1.0	600	150	1.0	600		D015
1N4947					800	250		800	15	
1N4948					1000	500		1000	10	
1N5816		/478		20	150	35	10.0	150	400	D04
1N6073					50			50		
1N6074				0.85	100		1.0	100	35	
1N6075					150			150		
1N6076					50			50		
1N6077		/503		1.3	100	30	5.0	100	75	4
1N6078					150			150		
1N6079					50			50		
1N6080				2.0	100		10.0	100	175	
1N6081					150			150		

NOTES:

1. See MIL-STD-975 for additional types.
2. See Note 1 on Page 08-1.
3. See Note 2 on Page 08-2.
4. This case does not meet the dimensional criteria for any JEDEC outline. See MIL-S-19500 detail specification for case outline dimensions.

DIODES Power, Silicon¹

Grade 12	Grade 2	Specification MIL-S-19500	Manufacturer	Maximum Forward Voltage [V (pk)]	Forward Current [A (pk)]	Maximum Reverse Current		Reverse Recovery Time t_{rr} (μ sec)	Case Dwg.
Type Designation JANS	Type Designation JANTXV3					25°C (μ Adc)	150°C (mAdc) @ Voltage (Vdc)		
1N4245		/286	OPL-19500	1.3	3.0	1.0	.15	200	5
1N4247								600	
1N4249								1000	
									D015

DIODES Voltage Variable Capacitor, Silicon

Grade 12		Grade 2	Specification MIL-S-19500	Manufacturer	Nominal Cap. @V _R = 4 Vdc (pF)	Cap. Ratio V _i = 4v to 60v (times)	Max. Cont. Work. Volts V _R (volts)	Min. Q @f = 50 MHz V _R = 4 vdc	Max. Diss. (W)	Max. Temp. (°C)	Case Dwg.				
Type Designation JANS	Type Designation JANTXV3														
1N5139A		/383	OPL-19500	6.8	2.7	60	350	200	0.4	175°C	D07				
1N5140A				10	2.8		300								
1N5141A				12			250								
1N5142A				15											
1N5143A				18	3.2										
1N5144A				22											
1N5145A				27											
1N5146A				33											
1N5147A				39											
1N5148A				47											

NOTES: 1. See MIL-STD-975 for additional types.
2. See Note 1 on Page 08-1.
3. See Note 2 on Page 08-2.

Index of Preferred Transistors

Grade 1 ¹	Grade 2	Function	Refer To
JANS	JANTXV ²	Type No.	
G3000		Microwave, Power	Page 09-4
G3001			
G3005			
	2N718A	Low Power - NPN	Page 09-2
	2N918	RF - NPN	MIL-STD-975
	2N1613	Medium Power - NPN	Page 09-3
	2N2060	Dual - NPN	
	2N2219A	Medium Power - NPN	
	2N2222A	Low Power - NPN	MIL-STD-975
	2N2369A	Chopper - NPN	
	2N2432A	Low Power - NPN	
	2N2484	Low Power - PNP	
	2N2657	RF - NPN	Page 09-6
	2N2880	High Power - NPN	Page 09-4
	2N2905A	Medium Power - PNP	
	2N2907A	Low Power - PNP	MIL-STD-975
	2N2920	Dual - NPN	
	2N2944A	Chopper - PNP	Page 09-3
	2N2945A		MIL-STD-975
	2N2946A		
	2N3019	Medium Power - NPN	Page 09-3

Grade 1 ¹	Grade 2	Function	Refer To
JANS	JANTXV ²	Type No.	
	2N3251A	Low Power - PNP	Page 09-2
	3TX2N3330	J-FET (P-CH)	MIL-STD-975
	2N3375	RF - NPN	Page 09-6
	2N3553	RF - NPN	
	2N3637	Medium Power - PNP	MIL-STD-975
	2N3700	Low Power - NPN	
	2N3741	High Power - PNP	Page 09-4
	2N3749	High Power - NPN	MIL-STD-975
	2N3763	Medium Power - PNP	
	2N3765	Low Power - PNP	Page 09-2
	2N3792	High Power - PNP	
	2N3810	Dual - PNP	Page 09-4
	2N3811	Dual - PNP	MIL-STD-975
	2N3821	J-FET (N-CH)	Page 09-5
	2N3822		
	2N3823		MIL-STD-975
	2N3866	RF - NPN	Page 09-6
	2N3868	Medium Power - PNP	Page 09-2
	2N3955	High Power - NPN	
	2N4150	Medium Power - NPN	MIL-STD-975
	2N4399	High Power - PNP	
	2N4440	RF - NPN	Page 09-6

Grade 1 ¹	Grade 2	Function	Refer To
JANS	JANTXV ²	Type No.	
	2N4856	J-FET (N-CH)	MIL-STD-975
	2N4857		Page 09-5
	2N4858		Page 09-2
	2N4931	Medium Power - PNP	
	2N4948	Unijunction	MIL-STD-975
	2N4957	RF - PNP	
	2N5338	High Power - NPN	Page 09-4
	2N5114	J-FET (P-CH)	MIL-STD-975
	2N5250	High Power - NPN	Page 09-4
	2N5416	Low Power - PNP	MIL-STD-975
	2N5680	High Power - NPN	Page 09-4
	2N5682	Medium Power - NPN	Page 09-3
	2N5686	High Power - NPN	
	2N5687	High Power - NPN	MIL-STD-975
	2N5572	High Power - PNP	
	2N5745	High Power - PNP	Page 09-4
	2N6308	High Power - NPN	
	4N23	Photocoupler	MIL-STD-975
	4N23A		
	4N24		
	4N24A		

NOTES:

1. When no Grade 1 transistor is available, a Grade 2 transistor may be upgraded for use in Grade 1 applications in accordance with Appendix A.
2. JANTXV transistors must be rescreened in accordance with the applicable TX detail specification of MIL-S-19500, for use in Grade 2 applications.
3. This device is not available as JANS or JANTXV and is considered to be a NON-STANDARD part by GSFC.

TRANSISTORS

NPN, Silicon, Low Power¹

NPN, Silicon, Low Power ¹																	
Grade 12	Grade 2		Specification MIL-S-19500	Manufacturer	h _{FE} (min/max)	α			V _{CE} (SAT) (Vdc)	α		BV _{CEO} (Vdc)	P _T @T _A = 298K (mW) _i	Case Dwg.			
Type Designation JANS	Type Designation JANTXV3	I _C (mA _{dc})				V _{CE} (Vdc)	I _{CEO} (nA _{dc})	V _{CB} (Vdc)		I _C (mA _{dc})	I _B (mA _{dc})						
2N718A			/181	OPL-19500	40/120	150	10	10				1.5	150	15	75	500	TO18

TRANSISTORS

PNP, Silicon, Low Power¹

PNP, Silicon, Low Power¹

Grade 1 ²	Grade 2		Specification MIL-S-19500	Manufacturer	h _{FE} (min/max)	@		I _{CBO} (nAdc) @ (Vdc)	V _{CE} (SAT) (Vdc)	@		BV _{CEO} (Vdc)	P _T @T _A = 298K (mW)	Switching Time		Case Dwg.
	Type Designation JANS	Type Designation JANTXV3				I _C (mAadc)	V _{CE} (Vdc)			I _C (mAadc)	I _B (mAadc)			t _{on} (nsec)	t _{off} (nsec)	
2N3251A			/323	OPL-19500	100/300	-10	-1	-20	-40	-10	-1	-60	360	70	250	TO18
2N3765			/396		40/140	-500	-1	-100	-30	-0.5	-500	-50	500	43	115	TO46

TRANSISTORS

PNP, Silicon, Medium Power¹

PNP, Silicon, Medium Power ¹																
Grade 12	Grade 2	Specification MIL-S-19500	Manufacturer	β		V_{CE} @ (Vdc)		$V_{CE}(SAT)$ (Vdc)	α		P_T @ $T_A = 298K$ (mW)	Switching Time		Case Dwg.		
Type Designation JANS	Type Designation JANTXV3		h_{FE} (min/max)	I_C (mAdc)	V_{CE} (Vdc)	I_{CBO} (nA dc)	V_{CE} (Vdc)		I_C (mA dc)	I_B (mA dc)		t_{on} (nsec)	t_{off} (nsec)			
2N3763		/396		40/140	-1	-100	-30	-0.5	-500	-50	1000	43	115	TO5		
2N3868		/350	QPL-19500	30/150	-2	$I_{CEX} =$ -1000	$V_{CE} =$ -60Vdc					100	600			
2N4931		/397		50/200	-10	-500	-200	-1.2	-30	-3		not specified		TO39		

NOTES:

1. See MIL-STD-975 for additional types.
2. See Note 1 on Page 09-1.
3. See Note 2 on Page 09-1.

TRANSISTORS

NPN, Silicon, Medium Power¹

Grade 12	Grade 2	Specification MIL-S-19500	Manufacturer	h _{FE} (min/max)	@		I _{CBO} V _{CB} (nAAdc) @ (Vdc)	V _{CE} (SAT) (Vdc)	@		BV _{CBO} (Vdc)	P _T @T _A = 298K (mW)	Switching Time		Case Dwg.
					I _C (mAAdc)	V _{CE} (Vdc)			I _C (mAAdc)	I _B (mAAdc)			t _{on} (nsec)	t _{off} (nsec)	
Type Designation JANS	Type Designation JANTXV3	/181	OPL-19500	40/120	150	10	10	60	1.5	150	15	75	800	not specified	TO5
				100/300	150	10	I _{CE} S = 10nAAdc	V _{CE} = 90Vdc	0.2	150	15	140			
				40/120	500	5	100	200	0.4	1000	100	250			

TRANSISTORS

PNP, Chopper, Low Power, Silicon¹

Grade 12	Type Designation JANS	Grade 2 Type Designation JANTXV3	Specification MIL-S-19500	Manufacturer	h _{FE} (min)	I _C (mAadc)		V _{CE} (Vdc)	I _{EC} (mAadc) @ (Ohms)	f = 1kHz I _E = 0 and I _B (mAadc) I _E (μA)	V _{EC} (ofs) (max) (Vdc)	e		BV _{CBO} (Vdc)	P _T @T _A = 298K (mW)	Case Dwg.
						I _C (mAadc)	I _B (mAadc)					I _E (mAadc)	I _B (mAadc)			
		2N2944A	/382	OPL-19500	100	-1	-0.5	4	-1	100	-0.6	0	-1	-15	400	TO46
		2N2946A			50			8			-2.0			-40		

- NOTES:
1. See MIL-STD-975 for additional types.
 2. See Note 1 on Page 09-1.
 3. See Note 2 on Page 09-1.

TRANSISTORS
NPN, Silicon, High Power¹

Grade 12	Grade 2	Type Designation JANTXV3	Specification MIL-S-19500	Manufacturer	@			I _{CB0} (mAAdc)	V _{CB} (Vdc)	V _{CE} (SAT) (Vdc)	@		BV _{CB0} (Vdc)	P _T @T _C = 298K (Watts)	Case Dwg.
					h _{FE} (min/max)	I _C (Adc)	V _{CE} (Vdc)				I _C (Adc)	I _B (Adc)			
2N2880	2N5038	2N5250	/315	OPL-19500	40/120	1	5	0.0004	80	0.25	1	0.1	110	30@ T _C = 373K	4
					50/200	2	5	25	150	1.0	12	1.2	150	140	TO3
					30/90	20	5	I _{CE} = 0.1mAAdc	V _{CE} = 125Vdc	1.0	40	4	125	350	4
					40/120	0.5	5	0.0001	200	0.4	1	0.1	250	20@ T _C = 373K	TO66

TRANSISTORS
PNP, Silicon, High Power¹

Grade 12	Type Designation JANS	Grade 2 Type Designation JANXXV3	Specification MIL-S-19500	Manufacturer	@			V _{CE} (SAT) (Vdc)	@		V _{CB} (Vdc) @ (mAdc)	h _{FE} (min/max)	P _T @ T _C = 298K (Watts)	Switching Time		Case Dwg.
					I _C (Adc)	V _{CE} (Vdc)	I _{CB0} (mAdc)									
2N3741	2N3792	2N5745	/441	OPL-19500	-0.250	-1	-0.0001	-80	-1	-0.125	-80	30/100	25	t _{on} (μ sec)	t _{off} (μ sec)	TO66
					-1	-2	I _{CE} = -1mAdc	V _{CE} = -70Vdc	-5	-0.5	-80	50/150	150	1.5	2.0	TO3
					-10	-2	-1	-80	-10	-1	-80	15/60	200	1.0	3.0	TO3
					-10	-2	-1	-80	-10	-1	-80	15/60	200	1.0	3.0	TO3

NOTES:

1. See MIL-STD-975 for additional types.
2. See Note 1 on Page 09-1.
3. See Note 2 on Page 09-1.
4. This case does not meet the dimensional criteria for any JEDEC outline. See MIL-S-19500 detail specification for case outline dimensions.

TRANSISTORS
Field-Effect, N-Channel, Junction, Silicon¹

Grade 1 ²	Grade 2		Specification MIL-S-19500	Manufacturer	V _{DG} and V _{DS} (max) (Vdc)	V _{GS} (max) (Vdc)	I _G (mA)	V _{GS} (off) max. (Vdc)	@		I _{DSS} (min/max) (mA)	@		P _T (mW)	Case Dwg.	
	Type Designation JANS	Type Designation JANTXV3							V _{DS} (Vdc)	I _D (nA)		V _{DS} (Vdc)	V _{GS} (Vdc)			
	2N3821		/375	QPL-19500	50	-50	10	-4	15	0.5	0.5/2.5	15	0	300	TO72	
	2N3822										2/10					
	2N4857		/385		40	-40	50	-6				20/100			360	TO18
	2N4858											8/80				

NOTES:

1. See MIL-STD-975 for additional types.
2. See Note 1 on Page 09-1.
3. See Note 2 on Page 09-1.

TRANSISTORS
RF, NPN, Silicon¹

Grade 1 ²		Grade 2		Specification	Manufacturer	hFE (min/max)	@		BVCEO (Volts)	P _{OUT} (min/max) (Watts)	@			P _T T _C = 298K (Watts)	Case Dwg.
Type Designation JANS	Type Designation JANTXV3	Type Designation JANTXV3	Type Designation JANTXV3				I _C (mA dc)	V _{CE} (V dc)			P _{IN} (Watts)	f (MHz)	η (%)		
G3000 ⁴	G3001 ⁴	G3004 ⁴	GSFC S-311-35	Microwave Semiconductor Corp.		15/120	100	5	50	G _{PB} = 11.0db min.		2250		Not Specified ⁵	Microwave Pkg.
			GSFC S-311-36							G _{PB} = 10.8db min.					
			GSFC S-311-37							G _{PB} = 8.0db min.					
2N2857			MIL-S-19500 /343	QPL-19500		30/150	3	1	30	G _{PB} = 12.5/21db		450		0.3	TO72
2N3375			MIL-S-19500 /341			15/150	150	5	65	7.5/14 3/6	1 1	100 400	65 40	11.6	TO60
2N3553										2.5/5	0.25	175	50	7.0	TO39
2N3866			MIL-S-19500 /398			15/200	50		60	1/2 0.5 min.	0.15 0.075	400 400	45 40	1.0 @ T _A = 298K	
2N4440			MIL-S-19500 /341							10/16 4/8	1 1	100 400	65 40	11.6	TO60

NOTES:

1. See MIL-STD-975 for additional types.
2. See Note 1 on Page 09-1.
3. See Note 2 on Page 09-1.
4. This is a Grade 1 device.
5. Power dissipation is determined by the type of heat sink used with the device.

INDEX TO PREFERRED MICROCIRCUITS^{1,2,3}

LINEAR		DIGITAL	
Operational Amplifier	LM101A	Low Power Schottky, TTL	54LS00
	LM108A		54LS02
	LM118		54LS03
	LM741		54LS04
Voltage Regulator	LM747		54LS05
			54LS08
			54LS10
			54LS11
Voltage Comparators	LM140K05		54LS12
	LM140K12		54LS13
	LM140K15		54LS14
	LM140K24		54LS15
Line Driver	LM723		54LS16
			54LS17
			54LS18
			54LS19
Line Receiver	LM106		54LS20
	LM111		54LS21
	LM139		54LS22
	LM710		54LS23
Precision Timer	LM711		54LS24
			54LS25
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			54LS27
CMOS			54LS28
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MICROPROCESSOR			54LS32
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RAM			54LS36
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MEMORY			54LS40
			54LS41
			54LS42
			54LS43
PROM			54LS44
			54LS45
			54LS46
			54LS47
RDM			54LS48
			54LS49
			54LS50
			54LS51
MICROPROCESSOR			54LS52
			54LS53
			54LS54
			54LS55
MICROPROCESSOR			54LS56
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MICROPROCESSOR			54LS60
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MICROPROCESSOR			54LS64
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MICROPROCESSOR			54LS136
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			54LS138
			54LS139
MICROPROCESSOR			54LS140
			54LS141
			54LS142
			54LS143
MICROPROCESSOR			54LS144
			54LS145
			54LS146
			54LS147
MICROPROCESSOR			54LS148
			54LS149
			54LS150
			54LS151
MICROPROCESSOR			54LS152
			54LS153
			54LS154
			54LS155
MICROPROCESSOR			54LS156
			54LS157
			54LS158
			54LS159
MICROPROCESSOR			54LS160
			54LS161
			54LS162
			54LS163
MICROPROCESSOR			54LS164
			54LS165
			54LS166
			54LS167
MICROPROCESSOR			54LS168
			54LS169
			54LS170
			54LS171
MICROPROCESSOR			54LS172
			54LS173
			54LS174
			54LS175
MICROPROCESSOR			54LS176
			54LS177
			54LS178
			54LS179
MICROPROCESSOR			54LS180
			54LS181
			54LS182
			54LS183
MICROPROCESSOR			54LS184
			54LS185
			54LS186
			54LS187
MICROPROCESSOR			54LS188
			54LS189
			54LS190
			54LS191
MICROPROCESSOR			54LS192
			54LS193
			54LS194
			54LS195
MICROPROCESSOR			54LS196
			54LS197
			54LS198
			54LS199
MICROPROCESSOR			54LS200
			54LS201
			54LS202
			54LS203
MICROPROCESSOR			54LS204
			54LS205
			54LS206
			54LS207
MICROPROCESSOR			54LS208
			54LS209
			54LS210
			54LS211
MICROPROCESSOR			54LS212
			54LS213
			54LS214
			54LS215
MICROPROCESSOR			54LS216
			54LS217
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			54LS219
MICROPROCESSOR			54LS220
			54LS221
			54LS222
			54LS223
MICROPROCESSOR			54LS224
			54LS225
			54LS226
			54LS227
MICROPROCESSOR			54LS228
			54LS229
			54LS230
			54LS231
MICROPROCESSOR			54LS232
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			54LS234
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MICROPROCESSOR			54LS236
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MICROPROCESSOR			54LS240
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MICROPROCESSOR			54LS244
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MICROPROCESSOR			54LS248
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MICROPROCESSOR			54LS252
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MICROPROCESSOR			54LS256
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MICROPROCESSOR			54LS260
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			54LS262
			54LS263
MICROPROCESSOR			54LS264
			54LS265
			54LS266
			54LS267
MICROPROCESSOR			54LS268
			54LS269
			54LS270
			54LS271
MICROPROCESSOR			54LS272
			54LS273
			54LS274
			54LS275
MICROPROCESSOR			54LS276
			54LS277
			54LS278
			54LS279
MICROPROCESSOR			54LS280
			54LS281
			54LS282
			54LS283
MICROPROCESSOR			54LS284
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MICROPROCESSOR			54LS288
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MICROPROCESSOR			54LS292
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			54LS295
MICROPROCESSOR			54LS296
			54LS297
			54LS298
			54LS299
MICROPROCESSOR			54LS300
			54LS301
			54LS302
			54LS303
MICROPROCESSOR			54LS304
			54LS305
			54LS306
			54LS307
MICROPROCESSOR			54LS308
			54LS309
			54LS310
			54LS311

MICROCIRCUIT INFORMATION

HYBRID MICROCIRCUITS

Hybrid microcircuits are defined as parts which are comprised of any one of a combination of the following: multiple semiconductor chips (integrated circuits and/or discrete diodes or transistors), thin or thick films, and discrete passive elements. Since many processing techniques for hybrids are similar to those for monolithic microcircuitry, similar precautions and procedures for their procurement should be observed. Hybrid microcircuits by their nature tend to be low volume non-standard parts. Procedural guidelines for the procurement of nonstandard hybrid and monolithic microcircuits are given in the following paragraph.

MONOLITHIC AND HYBRID MICROCIRCUITS NOT LISTED

For various types of monolithic and hybrid microcircuits not included in MIL-STD-975 and this PPL, the following procedures are suggested as a consequence of problems commonly referred to the GSFC Parts Branch:

1. A survey of the manufacturer's hybrid or IC microcircuit facility should be performed.
2. Since hybrid circuits may contain critical circuit assemblies approaching subsystems in complexity and function, a design review, including parts stress analysis is advised.
3. A sample quantity of each microcircuit order should be subjected to evaluation tests and internal inspection (Construction Analysis). Monolithic microcircuits shall be screened in accordance with MIL-STD-883, Method 5004, to the required screening level outlined in Appendix C.
4. Procurement specifications for hybrid microcircuits shall require qualification, lot acceptance, and screening to assure that the discrete parts used within hybrids are selected and screened with the same care as for monolithic microcircuits. For procurement and product assurance guidelines for hybrid microcircuits, consult the GSFC Specification for Hybrid Microcircuit Requirements, S-311-74 Rev. A., and your project parts engineer.
5. Environmental test levels for both monolithic and hybrid microcircuits shall be tailored to the processing techniques so as not to produce overstress.

Solder, Rosin Core

Type No. 1,2	Approx. Gauge (AWG)	Tin Content (%)	Lead Content (%)	Antimony Content (%)	Max. Total Other Constituents Content (%)	Approx. Melting Range °C		Specification	Manufacturer
						Solidus	Liquidus		
SN60WRMAP SN60WRP SN60WRAP	16, 18, 20	59.5-61.5	39.8 - 37.5	0.20-0.50	0.47	182	190	QQ-S-571	Per OPL-QQ-S-571
SN63WRMAP SN63WRP SN63WRAP	16, 18, 20	62.5-63.5	36.8 - 35.5	0.20-0.50	0.47	182	182	QQ-S-571	Per OPL-QQ-S-571

NOTES:

1. As a guide the recommended order of use for these solders and fluxes and the procedure for cleaning after soldering is as follows:

- Type RMA flux is suitable for all electronic applications. (RMA is rosin core/mildly activated)
- Type R may be used in critical applications such as in extremely low leakage circuits. A good joint may be more difficult to obtain with R than with type RMA. (R is rosin core/non-activated)
- Type RA may be used when a joint cannot be made with RMA or R. (RA is rosin core/activated)
- Cleaning requirements: All three fluxes, R, RMA, and RA must be cleaned with one of the solvents listed below after soldering:

- Ethyl alcohol, ACS grade.
- Isopropyl alcohol, ACS grade.
- Trichlorotrifluoroethane, ACS grade.
- Any mixture of these.

(e) The degree of corrosiveness of the fluxes are as follows:

- R - least corrosive
RMA - moderately corrosive
RA - most corrosive

2. Refer to NASA publication NHB5300.4(3A-1), Requirements for Soldered Electrical Connections.

Index of Preferred Thermistors

Style	Description	Specification	Refer To
311P18	Thermistor, Insulated, Negative Temp. Coeff.	S311-P-18(GSFC)	Page 14-1
RTH	Thermistor, Insulated, Positive Temp. Coeff.	MIL-T-23648	MIL-STD-975

THERMISTORS¹ **[Temperature Sensitive Resistors]**

Temp. Coeff.	Resistance (ohms)	Tolerance at 25°C (±%)	Operating Temperature Range (°C)	Resistance Ratio $R_{25°C}/R_{MAX}$	Grade 1 and Grade 2		
					Part Number ²	Specification	Manufacturer
Neg.	2252	1	-55 to 90	10.93	311P18-02LXXX	GSFC S-311P-18	Yellow Springs Instrument
	2252	0.5	-55 to 70	5.71	311P18-02LXXX		
	3000	1	-55 to 90	10.91	311P18-03LXXX		
	3000	0.5	-55 to 70	5.71	311P18-04LXXX		
	5000	1	-55 to 90	10.91	311P18-05LXXX		
	5000	0.5	-55 to 70	5.71	311P18-06LXXX		
	10000	1	-55 to 90	9.23	311P18-07LXXX		
	10000	0.5	-55 to 70	5.03	311P18-08LXXX		
	30000	1	-55 to 90	10.72	311P18-09LXXX		
	30000	0.5	-55 to 70	5.60	311P18-10LXXX		

NOTES:

1. WARNING: Use heat sinks when soldering or welding to thermistor leads.
2. The complete part number is 311P18-
AA L XXX

DASH NUMBER
(01, 02, etc.)

LEAD STYLE:
S = 32 AWG, Type C per MIL-STD-1276
T = 28 AWG, Type ET per MIL-W-16876
N = 32 AWG, Type N-2 per MIL-STD-1276
E = Insulated lead (TFE), 32 AWG per MIL-I-22129; Bare lead, Style S; Tubing (FEP), M23053/11-105c.

LEAD LENGTH:
Specify length in centimeters.
1R0 = 1.0, 10R = 10, 101 = 100.
Minimum length is 7.6 cm.

Index of Preferred Transformers

MIL Style	Description	Specification	Refer To
M27/103	Audio Frequency	MIL-T-27	MIL-STD-975
M27/165	Audio Frequency	MIL-T-27	MIL-STD-975
M27/166	Audio Frequency	MIL-T-27	MIL-STD-975
M27/197	Audio Frequency	MIL-T-27	MIL-STD-975
M21038/9-005	Pulse, Low Power	MIL-T-21038	MIL-STD-975

Index of Preferred Wire/Cable

Style	Description	Specification	Refer To
M22759/11 and /9	Wire, High temperature	MIL-W-22759	Page 16-2
M22759/18	Wire, Light weight	MIL-W-22759	Page 16-3
S311P13	Wire, High voltage	S-311-P-13(GSFC)	Page 16-4
M22759/3/11/ 12/16/22/23	Wire, Extruded TFE	MIL-W-22759	MIL-STD-975
M81381	Wire, Fluorocarbon-Polymide	MIL-W-81381	MIL-STD-975
M16878	Wire, High Temperature	MIL-W-16878	MIL-STD-975
M5086	Wire, PVC insulated	MIL-W-5086	MIL-STD-975
M17	Cable, RF, Flexible, Coaxial	MIL-C-17	MIL-STD-975
M27500	Cable, Electrical, Shielded and Unshielded	MIL-C-27500	MIL-STD-975

WIRE **Electrical, Insulated, High Temperature**

MIL Style ¹	Strands No. x AWG #	Diameter over Insulation, mm		Voltage Rating, Maximum (volts/RMS)	Specification MIL-W-22759	Grade 1	Grade 2	Remarks
		Minimum	Maximum			Manufacturer		
M22759/11-28-X	7 x 36	.79	.90	600	/11	QPL-22759/11		Silver-coated, copper conductor Insulated with extruded TFE Suitable for UHF Maximum Temperature 200°C
M22759/11-26-X	19 x 38	.91	1.02					
M22759/11-24-X	19 x 36	1.04	1.14					
M22759/11-22-X	19 x 34	1.19	1.30					
M22759/11-20-X	19 x 32	1.42	1.52					
M22759/11-18-X	19 x 30	1.68	1.78					
M22759/11-16-X	19 x 29	1.85	1.96					
M22759/11-14-X	19 x 27	2.24	2.34					
M22759/11-12-X	19 x 25	2.74	2.90					
M22759/11-10-X	37 x 26	3.43	3.63					
M22759/11- 8-X	33 x 29	5.03	5.23					
M22759/9-22-X	19 x 34	1.47	1.57	1000	/9	QPL-22759/9		
M22759/9-20-X	19 x 32	1.68	1.78					
M22759/9-18-X	19 x 30	1.93	2.03					
M22759/9-16-X	19 x 29	2.11	2.21					

NOTES:

1. For the "X" suffix, substitute the appropriate color code designator from MIL-STD-681 (listed on page 16-5).

WIRE
Electrical, Insulated, Lightweight

MIL Style ¹	Strands No. x AWG #	Diameter over Insulation, mm		Voltage Rating, Maximum (volts/RMS)	Specification MIL-W-22759	Grade 1	Grade 2	Remarks
		Minimum	Maximum			Manufacturer		
M22759/18-26-X	19 x 38	.762	.864	600	/18	QPL-22759/18		Tin-coated copper conductor Insulated with extruded ETFE Maximum tem- perature 150°C; suitable for use as hookup wire.
M22759/18-24-X	19 x 36	.864	.965					
M22759/18-22-X	19 x 34	1.04	1.14					
M22759/18-20-X	19 x 32	1.24	1.35					
M22759/18-18-X	19 x 30	1.50	1.60					
M22759/18-16-X	19 x 29	1.65	1.75					
M22759/18-14-X	19 x 27	2.01	2.11					
M22759/18-12-X	37 x 28	2.57	2.67					
M22759/18-10-X	37 x 26	3.15	3.25					

NOTES:

1. For the "X" suffix, substitute the appropriate color code designator from MIL-STD-551 (listed on Page 16-5).

WIRE Electrical, Insulated

Style ¹	600 Volt		1000 Volt		2500 Volt		Specification	Grade 1	Grade 2	Remarks
	Strands No. x AWG #	Diameter over Insulation, mm. Max.	Strands No. x AWG #	Diameter over Insulation, mm. Max.	Strands No. x AWG #	Diameter over Insulation, mm. Max.		Manufacturer		
S311P13-XX-30-Z	7 x 38	.71	—	—	—	—	GSFC S-311-P-13	Raychem Corp.		Tin-coated, copper conductor. Insulated with crosslinked polyalkene. Max. Temp. 135°C Suitable for use in wire harnesses.
S311P13-XX-28-Z	7 x 36	.79	7 x 36	.86	—	—				
S311P13-XX-26-Z	7 x 34	.89	7 x 34	1.04	—	—				
S311P13-XX-24-Z	19 x 36	1.04	19 x 36	1.17	19 x 36	1.50				
S311P13-XX-22-Z	19 x 34	1.22	19 x 34	1.35	19 x 34	1.80				
S311P13-XX-20-Z	19 x 32	1.42	19 x 32	1.55	19 x 32	2.03				
S311P13-XX-18-Z	19 x 30	1.68	19 x 30	1.88	19 x 30	2.29				
S311P13-XX-16-Z	19 x 29	1.88	19 x 29	2.08	19 x 29	2.54				
S311P13-XX-14-Z	19 x 27	2.29	19 x 27	2.49	19 x 27	3.00				
S311P13-XX-12-Z	37 x 28	2.84	19 x 25	3.23	19 x 25	3.71				
S311P13-XX-10-Z	—	—	37 x 26	3.61	37 x 26	4.19				
S311P13-XX-8-Z	—	—	133 x 29	5.28	133 x 29	5.79				
S311P13-XX-6-Z	—	—	—	—	133 x 27	7.06				
S311P13-XX-4-Z	—	—	—	—	133 x 25	8.53				
S311P13-XX-2-Z	—	—	—	—	665 x 30	10.1				
S311P13-XX-0-Z	—	—	—	—	1045 x 30	12.4				
S311P13-XX-00-Z	—	—	—	—	1330 x 30	14.2				

NOTES:

1. The complete part number is S311P13-XX-YY-Z

VOL. TAGE RATING
01 = 600 volts
02 = 1000 volts
03 = 2500 volts

WIRE SIZE
AWG #

COLOR CODE
See page 16-6

**Color Code Designators
for Wire According to MIL-STD-681**

Base Color	1st Stripe	2nd Stripe	Designator	Base Color	1st Stripe	2nd Stripe	Designator	Base Color	1st Stripe	2nd Stripe	Designator
Black			0	White	Black	Brown	901	White	Orange	Yellow	934
Brown			1	White	Black	Red	902	White	Orange	Green	935
Red			2	White	Black	Orange	903	White	Orange	Blue	936
Orange			3	White	Black	Yellow	904	White	Orange	Violet	937
Yellow			4	White	Black	Green	905	White	Orange	Gray	938
Green			5	White	Black	Blue	906	White	Yellow	Green	945
Blue			6	White	Black	Violet	907	White	Yellow	Blue	946
Violet			7	White	Black	Gray	908	White	Yellow	Violet	947
Gray			8	White	Black			White	Yellow	Gray	948
White			9	White	Brown	Red	912	White	Green	Blue	956
				White	Brown	Orange	913	White	Green	Violet	957
White	Black		90	White	Brown	Yellow	914	White	Green	Gray	958
White	Brown		91	White	Brown	Green	915	White	Blue	Blue	967
White	Red		92	White	Brown	Blue	916	White	Blue	Gray	968
White	Orange		93	White	Brown	Violet	917	White	Violet	Violet	978
White	Yellow		94	White	Brown	Gray	918	White	Blue	Gray	
White	Green		95	White	Red	Orange	923	White	Violet	Gray	
White	Blue		96	White	Red	Yellow	924	White	Violet	Gray	
White	Violet		97	White	Red	Green	925	White			
White	Gray		98	White	Red	Blue	926	White			
				White	Red	Violet	927	White			
				White	Red	Gray	928	White			

APPENDIX A
Upgrading Grade 2 Devices
for Use in Grade 1 Applications

Both PPL-15 and MIL-STD-975C have sections in which the listed Grade 1 part is not available at this time or, in the case of the NSPL, no Grade 1 part is listed. This appendix lists what is required by GSFC to upgrade a Grade 2 device for use in a Grade 1 application. In most cases, GSFC requirements are the same as those in the NSPL. GSFC does not allow the upgrading of relays. The PPL has differences from the NSPL in the procedures to upgrade semiconductor devices. In all cases, the upgrading of a Grade 2 part for a Grade 1 application requires the approval of the project parts engineer.

Section 1 -- CAPACITORS

For styles listed in MIL-STD-975C, see Appendix B of that document. For styles listed in PPL-15, where the appropriate Failure Rate Level is not available, the approval of the project parts engineer is required to use the next lowest available level.

Section 3 -- FILTERS

Consult the project parts engineer.

Section 4 -- FUSES

GSFC considers the fuses in Section 4 of PPL-15 to be suitable for Grade 1 use as listed in the PPL.

Section 5 -- INDUCTORS

For styles listed in MIL-STD-975, see Appendix B of that document.

Section 6 -- RELAYS

GSFC does not consider any of the MIL-R-39016 relays in MIL-STD-975 suitable for upgrading to Grade 1. If it is not possible to use one of the S-311-P-2(06) relays listed in PPL-15, then consult the projects parts engineer for advice in selection of a suitable relay.

Section 7 -- RESISTORS

When the appropriate Failure Rate Level is not available, the approval of the project parts engineer is required to use the next lowest available level.

Section 8 -- DIODES

Grade 2 diodes listed in PPL-15 and MIL-STD-975C may be upgraded for use in Grade 1 applications by two methods:

- (a) In accordance with Appendix B of MIL-STD-975C.
- (b) When a procurement consists of not more than 100 devices, perform destructive physical analysis on 5 diodes from the lot and rescreen the JTXV diodes to the JANS screening requirements (except for internal visual inspection).

Section 9 -- TRANSISTORS

Grade 2 transistors listed in PPL-15 and MIL-STD-975C may be upgraded for use in Grade 1 applications by two methods:

- (a) In accordance with Appendix B of MIL-STD-975C.
- (b) When a procurement consists of not more than 100 devices, perform destructive physical analysis on 5 transistors from the lot and rescreen the JTXV transistors to the JANS screening requirements (except for internal visual inspection).

Section 10 – MICROCIRCUITS

Grade 2 microcircuits listed in MIL-STD-975C may be upgraded for use in Grade 1 applications by two methods:

- (a) In accordance with Appendix B of MIL-STD-975C except that the "Internal Visual for DPA" test listed in Table 3.2 shall include a Scanning Electron Microscope (SEM) inspection according to MIL-STD-883, Method 2018 (test 2 parts – accept on zero (0) rejects).
- (b) When a procurement consists of not more than 100 devices, the screening given in Appendix B of MIL-STD-975C will be used and the following procedure will be substituted for the Group B tests listed in Table 3.2 of Appendix B of MIL-STD-975C. Choose 5 devices at random from the lot and subject them to the following tests:

Test	MIL-STD-883 Method	Qty. to Test/ Accept No.	Remarks
Lid Torque	2024	2/0	Glass Frit Seal packages only
Internal Visual	2013	5/0	
SEM Inspection	2018	2/0	
Bond Strength	2011	2/0	All bonds shall be pulled and meet the specified limit
Die Shear	2019	3/0	

Section 14 – THERMISTORS

For styles listed in MIL-STD-975C, consult your project parts engineer.

Section 15 – TRANSFORMERS

For styles listed in MIL-STD-975C, see Appendix B of that document.

Section 16 – WIRE and CABLE

For styles listed in MIL-STD-975C, consult your project parts engineer.

MISCELLANEOUS

For device types listed in MIL-STD-975C but not in PPL-15, consult your project parts engineer.

APPENDIX B

Parts Derating Factors

This appendix tabulates GSFC's recommendations for the derating of the component types listed in the NSPL and PPL-15. Many of these derating recommendations are identical to those given in MIL-STD-975C. Where differences occur, they are based on GSFC experiences and failure rates in MIL-HDBK-217C. These factors are guidelines and may have to be modified to suit the needs of a particular project. Such modifications are to be made only with the review and approval of the project.

Table 01.
Derating Outline for Capacitors

Dielectric Class	Derate to Following Percentage (%)			Maximum Ambient Operating Temperature °C
	Rated Voltage	Ripple Voltage	In-Rush Current	
Ceramic (CKR), (CDR)	60	N/A	70	85
Plastic Film (CRH) ¹	60			
Glass or Porcelain (CYR)	50			
Tantalum (Solid Electrolyte) (CSR)	50	75		50
>1 ohm/volt effective circuit impedance				
<1 ohm/volt effective circuit impedance <20 Volts				
<1 ohm/volt effective circuit impedance >20 Volts	30			
Tantalum (Wet Electrolyte) (CLR)	60			
Tantalum Foil (CLR)	50		70	

NOTES:

1. CRH styles are not approved for use in circuits where the energy is less than 500 μ joules.

Table 02. Derating Outline for Connectors

Number of Contacts Used in Connector	Contact Size	Maximum Current Per Contact ¹ (Amperes)							Maximum Operating Voltage
		Wire Size (AWG)							
		16	18	20	22	24	26	28	
1 to 4	16	13.0	9.2	6.5					25% of rated Dielectric Withstanding Voltage
1 to 4	20			6.0	4.5	3.3			
1 to 4	22				4.5	3.3	2.5	1.8	
5 to 14	16	9.0	7.0	5.0					
5 to 14	20			5.0	3.5	2.7			
5 to 14	22				3.5	2.7	1.9	1.4	
15 or more	16	6.5	5.0	3.7					
15 or more	20			3.7	2.5	2.0			
15 or more	22				2.5	2.0	1.4	1.0	

NOTE:

1. Maximum current may be carried by only 10% of the contacts at one time. At such time, the remaining contacts must be capable of carrying the remaining 90% of the current.

NOTE:

1. Maximum current may be carried by only 10% of the contacts at one time. At such time, other contacts should be limited to 100 mA.

Table 03. Derating Outline for EMI Filters

Class	Derate To	Maximum Ambient Temperature
All Filters	50% rated feed through current and 50% rated DC working voltage	85°C

NOTE: Consult the GSFC Parts Branch (Code 311) for assistance in derating other filter types.

Table 04. Derating Outline for Fuses

Fuse Current Rating (Amperes)	Derate to the Following (%) of Rated Current	Remarks
15	50%	1, 2, 3
10	50%	
5	50%	
2	50%	
1	45%	
1/2	40%	
3/8	35%	
1/4	30%	
1/8	25%	

NOTE:

1. Derating factors are based on data from fuses mounted on printed circuit boards and conformally coated. For other type mountings, consult the GSFC project parts engineer for recommendations.
2. Derating of fuses also allows for possible loss of pressure, which lowers the blow current rating and allows for a decrease of current capability with time.
3. Fuse current ratings are based on a measured blow current of 200% rated current for a maximum of 5 seconds to blow the fuse and a minimum ratio of 4/1 of blow to operating current. The minimum of 4/1 of blow to operating currents corresponds to the 50% derating factor. An 8/1 ratio of blow to operating currents corresponds to the 25% derating factor for the 1/8 ampere fuse. For maximum life in critical space applications, GSFC recommends an 8/1 ratio.

Table 05.
Derating Outline for Inductors/Coils

Class Per MIL-C-39010	Class Per MIL-C-15305	Maximum Operating Temperature	Derate To
-	O	65°C	50% of Maximum rated voltage.
A	A	85°C	
B	B	105°C	

NOTES:

1. a) Maximum operating temperature equals ambient temperature + temperature rise + 10°C (allowance for hot spot).
 Compute temperature rise as follows:

$$\text{Temperature rise } (^\circ\text{C}) = \frac{R \cdot I}{r} [T + 234.5]$$
 Where R = Winding resistance under load
 r = No load winding resistance at ambient temperature T (°C).
 b) The insulation classes of MIL style inductive parts have maximum operating temperature ratings which are generally based upon a life expectancy of at least 10,000 hrs. The maximum operating temperatures in this table are selected to extend the life expectancy to 50,000 hrs.
 c) Custom made inductive devices shall be evaluated on a materials basis and stressed at levels below the maximum rated operating temperature for the materials used. Devices having a maximum rated operating temperature in the range of 85°C to 130°C shall be derated to: Maximum Operating Temperature (°C) = .75 x Maximum Rated Operating Temperature (°C). For devices with maximum rated temperatures outside this temperature interval consult the project parts engineer for temperature derating recommendations.

Table 06.
Derating Outline for Relays

Class	Derate To	Remarks
All Relays	50% of rated contact current	Users are cautioned not to derate <u>coil</u> current or voltage, as this can result in non-operation of the device.

Table 07.
Derating Outline for Resistors

Type	Derate To	Remarks
Carbon composition, Style RCR	60% of Rated Power	<p>All resistors:</p> <p>(a) Maximum voltage shall not exceed 80% of the maximum rated voltage on any resistor.</p> <p>(b) Resistors with weldable nickel leads shall be derated by an additional factor of 0.5</p>
Film, General Purpose, Style RLR	60% of Rated Power	
Wirewound, Accurate, Style RBR		
1% Tolerance	60% of Rated Power	
0.5% Tolerance	35% of Rated Power	
0.1% Tolerance	25% of Rated Power	
Wirewound, Power, Chassis Mount, Style RER	60% of Rated Power	
Wirewound, Power, Style RWR	60% of Rated Power	
Variable Trimmers, Styles RTR & RJR	70% of Rated Current	
Thick Film, Style SHV	60% of Rated Power	
Film, High Stability, Style RNC	60% of Rated Power	

Table 08.
Derating Outline for Diodes

Class	Derate to the Following Percentage	
	Peak Inverse Voltage	Junction Temperature
Diodes, Rectifiers	75	601.2
Diodes, Small Signal Switching		
Diodes, Voltage Reference, Voltage Regulator, Current Regulator, Variable Capacitor		
Diodes, Silicon Controlled Rectifier, Voltage Suppressor, PIN, Schottky Barrier Switching, Light Emitting	Consult project parts engineer for identification of parameters to be derated and recommended derating factors. Derating will be determined on an individual part type basis.	

NOTE 1: All Devices

Derate junction temperature as follows:

$T_J(\text{derated}) = \text{Derating Factor } X [T_J(\text{max}) - 25^\circ\text{C}] + 25^\circ\text{C}$. = Maximum allowable operating junction temperature.
 $T_J(\text{max})$ = Manufacturer's specified maximum junction temperature.

NOTE 2: Derate average forward current (I_o) to satisfy junction temperature derating calculated in note 1, as follows:

Devices Operated Without Heat Sink (Figure 1)

$I_o(\text{allowed}) = \text{Derating Factor } X I_o(\text{max})$, $T_A \leq 25^\circ\text{C}$

$I_o(\text{allowed}) = \text{Derating Factor } X I_o(\text{max}) \left[\frac{T_A - 25^\circ\text{C}}{T_J(\text{derated}) - 25^\circ\text{C}} \right]$, $T_A > 25^\circ\text{C}$

$I_o(\text{max})$ = Manufacturer's absolute maximum current rating.

T_A = Ambient temperature.

Devices Operated With Heat Sink (Figure 2)

$I_o(\text{allowed}) = \text{Derating Factor } X I_o(\text{max})$, $T_{\text{case}} \leq T_D$

$I_o(\text{allowed}) = \text{Derating Factor } X I_o(\text{max}) \left[\frac{T_{\text{case}} - T_D}{T_J(\text{derated}) - T_D} \right]$, $T_{\text{case}} > T_D$

$T_D = T_J(\text{derated})$ - Derating Factor ($T_J(\text{derated}) - T_M$)

T_D = Case temperature above which I_o must be further derated to satisfy derated junction temperature.

T_M = Maximum case temperature at which manufacturer permits full rated current ($I_o(\text{max})$).

$I_o(\text{max})$ = Manufacturer's absolute maximum average forward current.

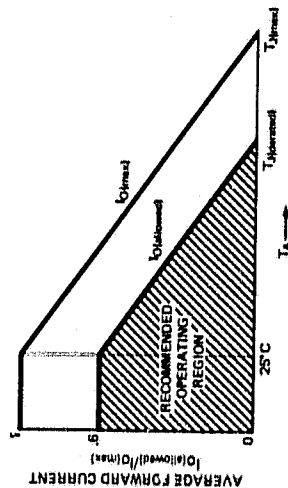


Figure 1. Derating curve from MIL-HDBK-217 modified to show operating region for devices operated without heat sinks and a Derating Factor of 0.6.

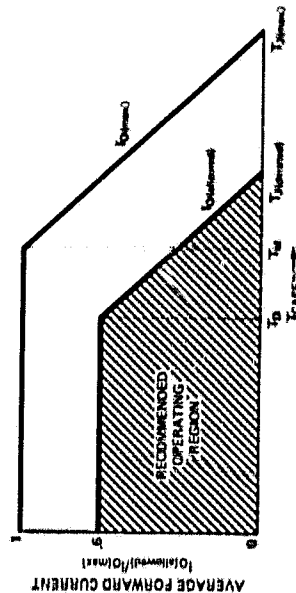


Figure 2. Derating curve from MIL-HDBK-217 modified to show operating region for devices operated with heat sinks and a Derating Factor of 0.6.

Table 09.
Derating Outline for Transistors

Class	Derate to the Following Percentage		
	Voltage	Current	Power
Silicon NPN, PNP Low power, Med. power, High power, Switching, Dual, Complimentary, Chopper, Unijunction.	75	75	60
J-FET, N-Channel, P-Channel General Purpose, Med. Power, High Power, High Speed Switching	75	75	60
RF NPN, Microwave Power, Phototransistor, Opto-coupler.			

Consult project parts engineer for identification of parameters to be derated and recommended derating factors. Derating will be determined on an individual part type basis.

NOTE 1: All devices:

Derate junction temperature as follows:

$T_J(\text{derated}) = \text{Derating Factor} \times [T_J(\text{max}) - 25^\circ\text{C}] + 25^\circ\text{C}$ = Maximum recommended operating junction temperature.
 $T_{J\text{max}}$ = Manufacturer's specified maximum junction temperature.

NOTE 2:

Derate power dissipation to satisfy the junction temperature derating calculated in Note 1, as follows:
 Devices operated without heat sink (Figure 1)

$P_D(\text{allowed}) = \text{Derating Factor} \times P_D(\text{max})$, $T_A \leq 25^\circ\text{C}$

$P_D(\text{allowed}) = \frac{T_J(\text{derated}) - T_A}{R_{\theta JA}}$, $T_A > 25^\circ\text{C}$

$P_{D\text{max}}$ = Mfr's absolute maximum power rating.

$R_{\theta JA}$ = Junction to ambient thermal resistance from mfr's data sheet ($^\circ\text{C}/\text{watt}$).

T_A = Ambient temperature.

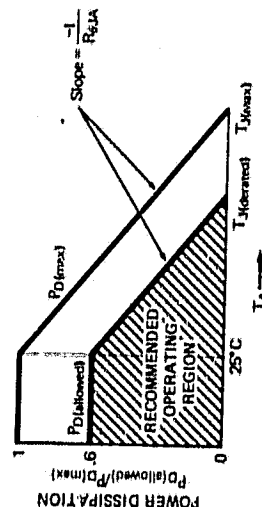


Figure 1. Derating curve from MIL-HDBK-217 modified to show operating region for devices operated without heat sinks and a Derating Factor of 0.6.

Devices operated with heat sink (Figure 2)

$P_D(\text{allowed}) = \text{Derating Factor} \times P_D(\text{max})$, $T_{\text{case}} \leq T_D$

$P_D(\text{allowed}) = \frac{T_J(\text{derated}) - T_{\text{case}}}{R_{\theta JC}}$, $T_{\text{case}} > T_D$

$T_D = T_J(\text{derated}) - R_{\theta JC}(\text{Derating Factor} \times P_{D\text{max}})$.

T_D = Case temperature above which power must be further reduced to satisfy junction temperature requirements.

$P_{D\text{max}}$ = Mfr's specified absolute maximum power rating.

$R_{\theta JC}$ = Junction to case thermal resistance specified in mfr's data sheet ($^\circ\text{C}/\text{watt}$).

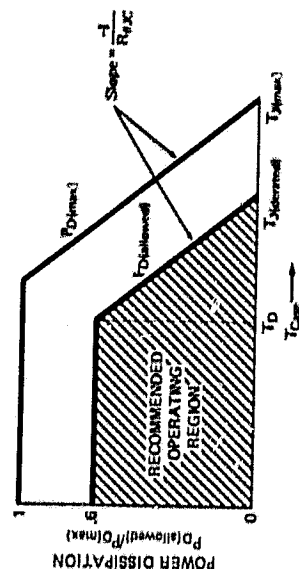


Figure 2. Derating curve from MIL-HDBK-217 modified to show operating region for devices operated with heat sinks and a Derating Factor of 0.6.

Table 10
Derating Outline for Microcircuits¹

Type		Derate to the Following Percentage			
		Supply Voltage	Power	Input Voltage	Output Current
Digital	TTL	100	80	100	80
	CMOS	70		70	
	NMOS	100		100	
Operational Amplifier		80	75	70	80
Voltage Regulator		N.A.	80	80	80 ²
Voltage Comparator		90	75	80	80
Sense Amplifier		80		70	
Current Amplifier		80		80	
Analog Switch		90	80	90	
Line Drivers and Receivers		100		100	

NOTES:

1. Maximum ambient temperature is 85°C.
2. Derate to 50% of rated current for two-terminal regulators.

Table 14.
Derating Outline for Thermistors
(Temperature Sensitive Resistor)

Class	Derate To
All Thermistors	50% of rated power

Table 15.
Derating Outline for Transformers

Class Per MIL-T-27	Class Per MIL-T-21038	Maximum Operating Temperature ¹	Derate To
Q	Q	65°C	50% of Maximum rated voltage.
R	R	85°C	
S	S	105°C	

NOTE:

1. a) Maximum operating temperature equals ambient temperature + temperature rise + 10°C (allowance for hot spot).
Compute temperature rise as follows:

$$\text{Temperature rise } (^\circ\text{C}) = \frac{R \cdot I}{r} (T + 234.5) \cdot (T - t)$$

Where R = Winding resistance under load.

r = No load winding resistance at ambient temperature T(°C).

t = Initial ambient temperature (°C).

T = Ambient temperature at power shutoff. T shall not differ from t by more than 5°C.

- b) The insulation classes of MIL style inductive parts have maximum operating temperature ratings which are generally based upon a life expectancy of at least 10,000 hrs. The maximum operating temperatures in this table are selected to extend the life expectancy to 50,000 hrs.

- c) Custom made inductive devices shall be evaluated on a materials basis and stressed at levels below the maximum rated operating temperature for the materials used. Devices having a maximum rated operating temperature in the range of 85°C to 130°C, shall be derated to: Maximum Operating Temperature (°C) = .75 x Maximum Rated Operating Temperature (°C). For devices with maximum rated temperatures outside this temperature interval consult the project parts engineer for temperature derating recommendations.

Table 16.
Derating Outline for Wire and Cable

Wire Size	Derate To - Amperes Maximum		Remarks
	Bundle or Cable	Single	
30	0.7	1.3	<p>1. Current ratings for bundles or cables are based on bundles of 15 or more wires at 70°C in a hard vacuum. For smaller bundles the allowable current may be proportionally increased as the bundle approaches a single wire.</p> <p>2. Ratings are based on Teflon insulated wire (Type TFE).</p>
28	1.0	1.8	
26	1.4	2.5	
24	2.0	3.3	
22	2.5	4.5	
20	3.7	6.5	
18	5.0	9.2	
16	6.5	13.0	
14	8.5	19.0	
12	11.5	25.0	
10	16.5	33.0	
8	23.0	44.0	
6	30.0	60.0	
4	40.0	81.0	
2	50.0	108.0	
0	75.0	147.0	
00	87.5	169.0	

APPENDIX C

Screening of Electronic Parts for Flight Equipment

This appendix to the PPL lists the minimum screening requirements which must be incorporated into procurement documents when nonstandard parts are to be procured. It specifies nominal levels of screening to be imposed on conventional MIL and commercial parts for flight applications when Established Reliability (ER), TXV, or parts to other high reliability MIL or NASA specifications are not available. (Refer to the Preface for a brief explanation of ER and TXV parts.) These screens are the minimum requirements to reduce the risk of fabricating into a system parts which do not meet advertised characteristics or which may fail latently in the system.

Because of the inherently higher risk with nonstandard parts, additional parts over the quantity needed for fabrication should be procured for test and analysis. Destructive physical analysis is recommended to ascertain the quality of construction and the workmanship applied in fabricating the parts. Step-stress testing, similar to that specified in MIL-STD-883, Method 5006, "Limit Testing", is recommended. It can yield information on failure modes to which the parts may be susceptible. These tests and analyses can determine if serious reliability hazards exist with parts for a particular application, and permit a better assessment of the risk incurred with their use.

A procurement document which is made up only of the parameters from the manufacturer's data sheet and the screens listed in the appropriate table of this appendix, is not comparable with military specifications or source controlled drawings which control other aspects of parts manufacture. The latter documents contain requirements for process controls, device construction, lot acceptance, and qualification in addition to screening. Ideally such documents should be developed for each nonstandard part, but the quantity of devices involved in a procurement, schedules, or economic constraints often preclude the development and use of such complete specifications.

For help in developing complete procurement requirements when a nonstandard part must be used, users are urged to consult their project parts engineers or the cognizant section of the Parts Branch.

Table 01.
Screening Outline for Capacitors¹

Test Sequence		1	2	3	4	5	6	Reference Documents MIL-STD-202
Category	Initial Examination per Reference Documents ²	Thermal Shock MIL-STD-202, Method 107	Seal Leak Tests MIL-STD-202, Method 112	Radiographic MIL-STD-202, Method 209	Conditioning per Referenced Documents	Final Examination per Reference Documents		
(a) Air or Glass, Variable	Visual & Mechanical, C, Q, DWV IR, Driving Torque	Test Condition A	N/A	N/A	N/A	Repeat Initial Examination	MIL-C-14409	
(b) Ceramic	Visual & Mechanical, C, DF, DWV, IR	Test Condition A, except step 3 shall be at max. rated temperature		In accordance with MIL-C-39014, N/A to style CD	2 x rated voltage @ max. rated tempera- ture for 96 hours		MIL-C-20 MIL-C-39014 MIL-C-55681	
(c) Glass & Porcelain		Test Condition B		N/A	2 x rated voltage @ 398 K for 96 hours		MIL-C-23269	
(d) Mica		Test Condition A, except step 3 shall be at max. rated temperature			2 x rated voltage @ max. rated tempera- ture for 96 hours		MIL-C-39001	
(e) Paper & Polyethylene terephthalate	Visual & Mechanical, C, DF, DWV, IR	Test Condition B	In accordance with MIL-C-19978	1.4 x rated voltage @ 125°C for 96 hours	MIL-C-19978			
(f) Polycarbonate, metallized film		Test Condition A, except step 3 shall be at 398 K	N/A	1.4 x rated voltage @ 100°C for 96 hours	MIL-C-83421			
(g) Tantalum Electrolytic, Wet Slug		Test Condition A		Acid Indicator test per GSFC SP 01.23	Rated voltage @ 85°C for 168 hours		MIL-C-39006 GSFC SP 01.23	
Foil	Test Conditions A and C Hermetic seal styles only							
(h) Tantalum Electrolytic, Solid (1) Hermetically sealed	Visual & Mechanical, C, DF, DC Leakage		Test Condition C	In accordance with MIL-C-39003	Rated voltage at 85°C		MIL-C-39003	
(2) Non-hermetically sealed			N/A	N/A	Rated voltage at 85°C Surge Current Test Per MIL-C-39003/6 ⁴	GSFC S-311-P-17(01)		
(i) High Voltage Ceramic	Visual & Mechanical ¹ C, DF, IR, DWV, dc Corona	Test Condition A	N/A		Rated Voltage? rated Temperature 100 hours	GSFC S-311-P-15(01)		

NOTES: 1. Test procedures and requirements are in accordance with those in the applicable MIL-STD-202. 2. Initial examination is required for all test items.

NOTES: 1. Test procedures and requirements are in accordance with those in the applicable Military or NASA referenced document. For additional information see the referenced document or consult the EEE Parts Section, Parts Branch. For complete procurement requirements, consult your Project Parts Engineer.

2. Legend: C = Capacitance, DF = Dissipation Factor, DWV = Dielectric Withstanding Voltage, IR = Insulation Resistance, Q = Quality Factor.

3. Voltage conditioning shall be conducted for 168 hours for polarized styles. For non-polarized styles, voltage conditioning shall be conducted for 192 hours with the voltage polarity reversed after 96 hours.

4. Surge current screening is required for devices intended for circuit applications having less than 3 ohm/volt effective circuit impedance. For non-polarized styles, the surge current test (when required) shall be in both directions (polarities).

Table 03.
Screening Outline for EMI Suppression Filters^{1,2}

Test Sequence Category	1	2	3	4	5	Reference Documents
	Initial Measurements and Examinations	Temperature Cycling	Seal Leak Tests	Voltage Conditioning	Final Measurements and Examinations	
Filters, EMI Suppression (with Ceramic Capacitor Elements)	1. Visual 2. Dielectric Withstanding Voltage (DWV) 3. Capacitance (when applicable) 4. Dissipation Factor (DF) (when applicable) 5. Insulation Resistance (IR) @ 25°C and rated elevated temperature 6. D.C. Resistance 7. Radiographic examination	5 cycles per MIL-STD-202 Method 107 Test Condition A. However, at no time shall either temperature extreme exceed the temperature rating of the filter.	Fine and Gross Leak tests. (Applicable to hermetically sealed devices, only.)	Rated voltage at rated elevated temperature for 240 hrs., minimum.	Repeat initial examinations and measurements, except radiographic examination. Add insertion loss tests. Select on basis of IR absolute values and stability.	GSFC S-311-P-5(03), Rev. 1 MIL-STD-202 MIL-STD-220

NOTES:

1. Consult the GSFC Parts Branch (Code 311) for assistance in screening other types of filters.
2. For complete procurement requirements, consult your Project Parts Engineer.

Table 04.
Screening Outline for Subminiature Fuses¹

Test Sequence Category	1		2	3	4	Reference Documents
	Initial Measurements		Thermal Shock	Final Measurements	Acceptance Criteria	
Fuses, Subminiature FM08, FM04	<p>Perform visual and mechanical inspections per paragraph 3.5 of MIL-F-23419.</p> <p>Measure cold resistance at 10% or less of rated current.</p> <p>Subject fuses to 100% rated current for not less than 5 minutes. Maintain current at this level and measure the voltage drop within the next 5 minutes Calculate R_{HOT1} (voltage drop/rated current)².</p>		MIL-STD-202 method 107, condition B	<p>Repeat Initial inspection and measurements</p> <p>Calculate = R_{HOT2}</p>	<p>GSFC recommends using fuses in lower half of the FM08 voltage drop range and those where R_{HOT1} and R_{HOT2} differ by less than 3%</p>	<p>MIL-F-23419</p> <p>MIL-F-23419/4</p> <p>MIL-F-23419.8</p>

NOTES:

1. For complete procurement requirements, consult your Project Parts Engineer.
2. Tests shall be designed to minimize the time, in excess of 5 minutes, that the fuses are subjected to full rated currents. These fuses should not be operated at rated currents for more than 30 minutes or parts may be degraded so that fuse life is reduced. MIL-F-23419 specifies minimum life at 110% of Rated Current to be 1.5 hours according to lot sampling tests. Rated current according to MIL-F-23419 is "the amount of current the fuse will carry indefinitely without interruption."

Table 05.
Screening Outline for Inductors/Coils¹

Test Sequence Category	1	2	3	4	Reference Document
	Initial Measurements	Thermal Shock	Burn-In	Final Measurements and Tests	
Coils, Fixed, Molded, RF	1. Visual Inspection 2. D.C. Resistance 3. Insulation Resistance (IR) 4. Dielectric Withstanding Voltage (DWV) 5. Inductance (L) 6. Q 7. Self Resonant Frequency (SRF)	MIL-STD-202 Method 107, Condition A-1, use maximum operating temperature of coil.	48 hrs. at rated current at rated maximum operating temperature.	Visual Inspection Repeat initial measurements. Reject criteria: $\Delta R > \pm 3\%$, $\Delta L > \pm 3\%$, $Q < \text{min. specified}$, $\text{SRF} < \text{min. specified}$, $\text{DWV} < \text{min. specified}$, $\text{IR} < \text{min. specified}$.	MIL-C-39010

NOTE:

1. For complete procurement requirements, consult your Project Parts Engineer.

Table 06.
General Screening Outline for Relays¹

Test Sequence	1	2	3	4	5	6	7	8	9	10	Reference Document ²
Category	External Visual Examination	Seal Leak Test	Initial Measurements	Vibration	High Temp Soak	Low Temp Miss Test	Room Temp Miss Test	Seal Leak Test	Final Measurements	External Visual Examination	
Relays - Latching and Non-Latching	Para. 3.5	Para. 3.6 Fine leak: Para. 3.6.1 Gross leak: Para. 3.6.2	Para. 3.7 Coil Resistance	Para. 3.8 100-2000 Hz 30g peak	Para. 3.10 16 hrs at 125°C	Para. 3.12 1000 operation miss test at -65°C	Para. 3.13 5000 operation miss test at 25°C	Para. 3.6.1 and 3.6.2 Repeat test sequence no. 2	Para. 3.7 Repeat test sequence no. 3	Para. 3.5	GSFC-S-311-P2(06) Contains procedures for these screening subtests.
			Pull In and Drop Out Voltage								
			Contact Resistance								
			Contact Transfer Characteristics								
			Insulation Resistance								
			Dielectric Strength								

NOTES:

1. For additional information, and to establish rejection criteria, see the reference documents or consult the EEE Parts Section, Parts Branch.
For complete procurement requirements, consult your Project Parts Engineer.
2. Other screening tests in this specification are provided for special applications.

Table 07.
Screening Outline for Resistors¹

Category	Test Sequence	1	2	3	4	5	Reference Document
		Initial Measurements	Thermal Shock	Conditioning	Seal Leak Test ²	Final Measurements	
Resistors, Fixed, Carbon Comp., RCR Style		Visual Inspection Resistance	—	—	—	—	MIL-R-39008 Group A Inspection
Resistors, Fixed, Film, General Purpose, RLR Style		Visual Inspection Resistance	—	1.5 x rated power at room temperature for 24 hours.	—	Visual Inspection Resistance Reject: $\Delta R > \pm 0.5\%$	MIL-R-39017 Group A Inspection
Resistors, Fixed, Film, High Stability, RNC Style		Visual Inspection Resistance	MIL-STD-202 Method 107 Cond. F	Style 50, 55, 60: 5 x rated power at room temperature for 1 hour. Style 65: 4 x rated power at room temperature for 1 hour. Style 70 and 75: 2.25 x rated power at room temperature for 1 hour. Style 90: 6.25 x rated power for 5 seconds at room temperature.	MIL-STD-883 Method 1014 Cond. D (For hermetically sealed units)	Visual Inspection Resistance Reject: $\Delta R > \pm 0.2\%$ Style 90: $\Delta R > \pm 0.05\%$	MIL-R-55182 Group A Inspection
Resistors, Fixed, Wirewound, Accurate, RBR Style		Visual Inspection Resistance	—	1.0 x rated power for 1.5 hours on, 0.5 hour off for 100 hours at 25°C.	—	Visual Inspection Resistance Reject: $\Delta R > \pm 0.01\%$	MIL-R-39005 Group A Inspection Subgroup 1
Resistors, Fixed, Wirewound, Power, RWR Style		Visual Inspection Resistance	—	1.0 x rated power for 1.5 hours on, 0.5 hour off for 100 hours at 25°C.	—	Visual Inspection Resistance Reject: $\Delta R > \pm 0.2\%$	MIL-R-39007 Group A Inspection
Resistors, Fixed, Wirewound, Power, Chassis Mount, RER Style		Visual Inspection Resistance	—	1.0 x rated "free air" power for 1.5 hours on, 0.5 hour off for 96 hours at 25°C.	—	Visual Inspection Resistance Reject: $\Delta R > \pm 0.2\%$	MIL-R-39009 Group A Inspection
Resistors, Variable, Wirewound, Low Power, RTR Style		Visual Inspection Resistance	—	1 watt power for 1.5 hours on, 0.5 hour off for 50 hours at 25°C.	—	Visual Inspection, Resistance, Peak Noise, Continuity, End Resistance, Torque Reject: $\Delta R > \pm 0.5\%$	MIL-R-39015 Group A Inspection
Resistors, Variable, Non-Wirewound, Low Power, RJR Style		Visual Inspection Resistance	—	1.5 x rated power for 1.5 hours on, 0.5 hour off for 50 hours at 25°C.	—	Visual Inspection, Resistance, End Contact Resistance, Torque Reject: $\Delta R > \pm 2\%$ (char. C) $\Delta R > \pm 1.5\%$ (char. F) $\Delta R > \pm 1\%$ (char. H)	MIL-R-39035 Group A Inspection

NOTES:

- For complete procurement requirements, consult your Project Parts Engineer.
- For resistors with nontransparent envelopes, perform the dye penetrant leak test of MIL-STD-883, Method 1014, Cond. D, except substitute the following post exposure inspection procedure:
 - thoroughly cleanse the resistors to remove external dye;
 - at a minimum temperature of 80°C rotate the resistors about their longitudinal axes (maintain the longitudinal axes horizontal) for a minimum of 2 minutes;
 - inspect for evidence of dye leakage.

**Table 08. (page 1 of 4)
Screening Outline for Diodes¹**

Test Sequence Part Category	1 Internal Visual (Precep) Inspection	2 Initial Insp. & Electrical Parameter Measurements	3 High Temperature Storage	4 Thermal Shock (Temperature Cycling)	5 Acceleration	6 PIND ²	7 FIST ³	8 BIST ⁴	9 Seal Leak Tests	10 Pre-Power and Reverse Bias Burn-In Electrical Measurements	11 Reverse Bias Burn-In
a. Diodes, Small Signal, Silicon			All devices shall be stored for 48 hrs at $T_A = 200^\circ\text{C}$. If leads are tinned or made of silver, the heating must be in an inert atmosphere or reduce temperature to $T_A = 125^\circ\text{C}$.	MIL-STD-750 Method 1051. (Refers to MIL-STD-202 Method 107 for procedural details.) Test Condition C, except 10 cycles total with 15 minutes rest at each temperature extreme.	MIL-STD-750 Method 2006, except test shall be 20,000 G in Y_1 orientation only, one time only.	MIL-STD-750 Method 2052	MIL-STD-750 Method 2061	MIL-STD-750 Method 2062	MIL-STD-750 Method 1071.1, Fine Leak: Test Condition G or H, Gross Leak: Test Condition C.	Serialize devices. Measure V_F and I_F . Record values and reject all devices that exceed their specified limits.	None
b. Diodes, Switching, Silicon	MIL-STD-750 Method 2074. (Since this test can only be performed by the manufacturer, specify internal inspection in procurement document.)	Visual Insp. per MIL-STD-750 Method 2071.							MIL-STD-750 Method 1038 Test Cond. A, 72 hrs at $T_A = 150^\circ\text{C}$. Note: at end of test V_F reverse applied until $T_A = 30^\circ\text{C}$.		
c. Diodes, Voltage Reference, Silicon									Same as above except 96 hrs at $T_A = 150^\circ\text{C}$ with I_F = rated value.		
d. Diodes, Voltage Regulator, Silicon		Measure all electrical parameters.	Same as above except $T_A = 175^\circ\text{C}$.	Same as above except maximum temperature is 175°C .		Only for Grade 1 screening.	Only for Grade 1 screening.	Only for Grade 1 screening.	Only for Grade 2 screening.	Same as above except measure BV , I_F and Z .	Same as above except 96 hrs at $T_A = 25^\circ\text{C}$ with I_F = maximum rated value.
e. Diodes, Power Rectifier, Silicon, (Fast Recovery or Gen. Purpose)										Same as Part Category a, except measure V_F and I_F .	None

Notes:

1. For complete procurement requirements, consult your project parts engineer.
2. PIND = Particle Impact Noise Detection
3. FIST = Forward Instability Shock Test
4. BIST = Backward Instability Shock Test

Table 08. (page 2 of 4)
Screening Outline for Diodes

Test Sequence Part Category		12	13	14	15	16	17	18
		Post Reverse Bias Burn-In Electrical Measurements	Power Burn-In	Post Power Burn-In Electrical Measurements	Final Electrical Parameter Measurements	Seal Leak Tests	Radiography	External Visual Examinations
a. Diodes, Small Signal, Silicon	None		MIL-STD-750 Method 1038 Test Condition B. 168 hours at specified V_F and I_F with $f = 60$ Hz.	Remeasure V_F and I_F . Record Values and reject devices that exceed their specified limits. In addition reject diodes exceeding the following delta (Δ) change: $\Delta V_F = \pm 2.5\%$, $\Delta I_F = 100\%$ or a number value determined for each diode part type, whichever is greater.	All electrical parameters of each device shall be measured as listed on the manufacturer's data sheet.	MIL-STD-750 Method 1071.1. Fine Leak Test Condition G or H. Gross Leak Test Condition C.	MIL-STD-750 Method 2076	MIL-STD-750 Method 2071
b. Diodes, Switching Silicon	Remeasure V_F and I_F . Delta (Δ) reject criteria for V_F and I_F are to be determined individual diode type.		None					
c. Diodes, Voltage Reference, Silicon	Remeasure BV and Z. Reject devices that exceed specified limits or exceed the following delta limits: $\Delta Z = \pm 10\%$ $\Delta BV =$ appropriate value determined for each part type.	None	None					
d. Diodes, Voltage Regulator, Silicon	Remeasure BV, I_F and Z. Reject devices that exceed specified limits or exceed the following delta limits: $\Delta BV = \pm 2\%$ $\Delta Z = 10\%$ $\Delta I_F = 100\%$ or a number value determined for each part type, whichever is greater.							
e. Diodes, Power Rectifiers, Silicon (Fast Recovery or General Purpose)	None	168 hours at $T_A = 25^\circ\text{C}$ for diodes with leads or $T_C = 100^\circ\text{C}$ (For stud mfg) with 60 Hz waveform applied to diode. During the half cycle when the diode is fwd biased, I_{FM} = max rated value. During reversed bias half cycle, V_R = max rated value.	Remeasure V_F and I_F . Follow above procedure a. and b. and use following delta changes: $\Delta V_F = \pm 9.1\%$ (μA) and $\Delta I_F = 100\%$ or a number value determined for each part type, whichever is greater.					

Table 08. (page 3 of 4)
Screening Outline for Diodes¹

Test Sequence Part Category	1 Internal Visual (Precep) Inspection	2 Initial Insp. & Electrical Parameter Measurements	3 High Temperature Storage	4 Thermal Shock (Temperature Cycling)	5 Acceleration	6 PIND ²	7 FIST ³	8 BIST ⁴	9 Seal Leak Tests	10 Pre-Power and Reverse Bias Burn-In Electrical Measurements	11 Reverse Bias Burn-In
g. Diodes, Voltage-Variable Capacitor, Silicon	MIL-STD-750 Method 2074. (Since this test can only be performed by the manufacturer, specify internal inspection in procurement document.)	Visual Insp. per MIL-STD-750 Method 2071.	All devices shall be stored for 48 hrs at $T_A = 200^\circ\text{C}$. If leads are tinned or made of silver, the heating must be in an inert atmosphere or reduce temperature to $T_A = 125^\circ\text{C}$.	MIL-STD-750 Method 105.1 (Refers to MIL-STD-202 Method 107 for procedural details). Test Condition C, except 10 cycles total with 15 minutes rest at each temperature extreme.	MIL-STD-750 Method 2006 except test shall be 20,000g only, one time only.	MIL-STD-750 Method 2052	MIL-STD-750 Method 2081	MIL-STD-750 Method 282	MIL-STD-750 Method 1071.1, Fine Leak Test Condition G or H, Gross Leak Test Condition C.	Serialize devices. Measure I_R . Record values and reject all devices that exceed their specified limits.	MIL-STD-750 Method 1038 Test Cond. A. 72 hrs at $T_A = 175^\circ\text{C}$. Note: at end of test V_R remains applied until $T_A = 30^\circ\text{C}$.
h. Thyristors, Silicon Controlled Rectifiers	MIL-STD-750 Method 2074. (Since this test can only be performed by the manufacturer, specify internal inspection in procurement document.)	Visual Insp. per MIL-STD-750 Method 2071.	Same as above except $T_A = 150^\circ\text{C}$	Same as above except Test Condition F.	Same as above except stress level to be determined by part size.	Only for Grade 1 screening	Only for Grade 1 screening	Only for Grade 1 screening	MIL-STD-750 Method 1071.1, Fine Leak Test Condition G or H, Gross Leak Test Condition C.	Same as above except measure I_{RAXM} , I_{FBXM} , V_F , V_{GT} , and I_{GT} .	Same as above except 96 hrs at $T_A = 125^\circ\text{C}$ with I_{OR} and V_{FBXM} at rated values. Note: Thyristors which burn on during this burn-in shall be rejected.
i. Diodes, Current Regulator, Silicon		Measure all electrical parameters.	Same as above except $T_A = 175^\circ\text{C}$	Same as above except high temperature = 125°C	Same as Part Category g. above.				Only for Grade 2 screening	Same as above except measure I_P only.	
j. Diodes, Switching, Schottky Barrier, Silicon			Same as above except $T_A = 200^\circ\text{C}$	Same as Part Category g. above.						Same as above except measure I_R and V_B only.	
k. Diodes, Switching, PIN			Same as above except $T_A = 150^\circ\text{C}$	Same as Part Category g. above except Test Condition F.						Same as above except measure I_R and V_B only.	None
l. Diodes, Light Emitting			Same as above except T_A limited to manufacturer's specified maximum storage temperature.	Same as above except temperature extremes limited to manufacturer's specified minimum and maximum storage temperature.	Same as above except acceleration in Z direction.				MIL-STD-750 Method 1071.1, Fine Leak Test Condition H, Gross Leak Test Condition E. Only for Grade 2 screening.	Measure and record values for V_F and P_O (Radiant Power Output). Reject devices not meeting specifications.	

Notes:

1. For complete procurement requirements, consult your project parts engineers.
2. PIND = Particle Impact Noise Detection
3. FIST = Forward Instability Shock Test
4. BIST = Backward Instability Shock Test

**Table 08. (page 4 of 4)
Screening Outline for Diodes**

Test Sequence	12	13	14	15	16	17	18
Part Category	Post Reverse Bias Burn-In Electrical Measurements	Power Burn-In	Post Power Burn-In Electrical Measurements	Final Electrical Parameter Measurements	Sold Leak Tests	Radiograph	External Visual Examination
g. Diodes, Voltage-Variable Capacitor, Silicon	Remeasure I_R . Reject devices that exceed specified limits or exceed the following delta limits: $\Delta I_R = 100\%$ or a number value determined for each part type, whichever is greater.	None	None	Visual Inspection per MIL-STD-750 Method 2071.	MIL-STD-750 Method 1071 J Fine Leak Test Condition G or H, Gross Leak Test Condition C Only for Grade 1 screening	MIL-STD-750 Method 2076	MIL-STD-750 Method 2071
h. Thyristors, Silicon Controlled Rectifiers	Remeasure I_{RBXM} , I_{FBXM} , VGT and I_{GT} . Follow procedure above and use the following delta changes: ΔI_{RBXM} = appropriate value ΔI_{FBXM} = appropriate value	168 hours at $T_A = 25^\circ\text{C}$ and P _{OV} (Peak Operating Voltage) = maximum rated value.	Remeasure I_p . Reject devices that exceed specified limits or exceed the following delta limits: $\Delta I_p = +5\%$ Remeasure V_B and I_R . Reject devices that exceed limits or exceed the following delta limits: $V_B = 10\%$ $\Delta I_R = 100\%$ or a number value determined for each part type, whichever is greater.	All electrical parameters of each device shall be measured as listed on the manufacturer's data sheet.	MIL-STD-750 Method 1071 J Fine Leak Test Condition H, Gross Leak Test Condition E only for Grade 1 screening	Only for Grade 1 screening	Only for Grade 1 screening
i. Diodes, Current Regulator, Silicon	None	MIL-STD-750 Method 1033 Test Condition B, 168 hours at $T_A = 25^\circ\text{C}$ at specified V_F and I_O with $f = 60\text{ Hz}$.	Remeasure V_F and I_R . Reject devices that exceed specified limits or exceed the following delta limits: $\Delta V_F = \pm 10\%$ ΔI_R = same as ΔI_R above.				
j. Diodes, Switching, Schottky Barrier, Silicon			Remeasure V_F and I_O . Reject devices not meeting specifications or exceeding the following delta limits: $\Delta V_F = \pm 2.5\%$ $\Delta P_O = -2.5\%$				
k. Diodes, Switching, PIN							
l. Diodes, Light Emitting		168 hours at T_A (or T_C) = 25°C $I_F = 80\%$ of maximum rated continuous forward current					

Table 09. (page 1 of 4)
Screening Outline for Transistors¹

Test Sequence Part Category	1 Internal Visual (Precep) Inspection	2 Initial Inspection & Electrical Parameter Measurements	3 High Temperature Storage	4 Thermal Shock (Temperature Cycling)	5 Acceleration	6 PIND 2	7 FIST 3	8 BIST 4	9 Seal Leak Tests
a. Transistors, Silicon, NPN, Low, Medium Power, Switching or General Purpose	MIL-STD-750 Method 2072. (Since this test can only be performed by the manufacturer, specify internal visual inspection in procurement document.)	Visual inspection per MIL-STD-750, Method 2071.	Store for 48 hours at $T_A = 200^\circ\text{C}$. (If lead are silver or tin plated the heating must be in an inert atmosphere or reduce temperature to $T_A = 125^\circ\text{C}$.)	MIL-STD-750 Method 1051. (Refer user to MIL-STD-202 Method 107 for procedural details). Test Condition C, except 10 cycles total with 15 minutes rest at each temperature extreme.	MIL-STD-750 Method 2008 except that test shall be 20,000 g in Y_1 orientation, one time only. The 1 min hold-time requirement shall not apply.	MIL-STD-750 Method 2052 Only for Grade 1 screening	MIL-STD-750 Method 2081 Only for Grade 1 screening	MIL-STD-750 Method 2082 Only for Grade 1 screening	MIL-STD-750 Method 1071.1 Fine Leak Test Condition G or H Gross Leak Test Condition C Only for Grade 2 screening
c. Transistors, Silicon, PNP, High Power		Measure all electrical parameters.			Same as above except 5,000 g.				Same as above except fine leak inspection value of 5×10^{-7} atm cc/sec. Only for Grade 2 screening
d. Transistors, Silicon, NPN, High Power					Same as above except 5,000 g.				MIL-STD-750 Method 1071.1 Fine Leak Test Condition G or H Gross Leak Test Condition C Only for Grade 2 screening
e. Transistors, Field-Effect, Junction, N-Channel, Silicon					Same as above except 5,000 g.				
f. Transistors, Field-Effect, Junction, P-Channel, Silicon					Same as above except 20,000 g.				

Notes:

1. For complete procurement requirements, consult your project parts engineer.
2. PIND = Particle Impact Noise Detection
3. FIST = Forward Insensitivity Shock Test
4. BIST = Backward Insensitivity Shock Test

Table 69. (page 2 of 4)
Screening Outline for Transistors

Test Sequence Part Category	10	11	12	13	14	15	16	17
	Reverse Bias Burn-In	Pre-Burn-In Electrical Measurements	Burn-In	Post Burn-In Tests	Electrical Parameter Measurements	Leak Tests	Radiography	External Visual Examination
a. Transistors, Silicon, NPN, Low, Medium Power, Switching or General Purpose	48 Hours at: $V_{CB} = 80\%$ of V_{CBO} $I_E = 0$ Reduce temperature to $T_A = 30^\circ\text{C}$ before reverse voltage is removed at end of test. Measure I_{CBO} and reject I_{CBO} that exceed their specified limits.	Measure I_{CBO} (or I_{GSS}) and I_{FE} . Record values and reject all devices that exceed limits. I_{CES} is measured when value for I_{CBO} is not specified.)	168 hrs at $T_A = 25^\circ\text{C}$ at specified V_{CB} (or V_{CE}) and P_T (max rated power dissipation at T_A).	Remeasure values of I_{CBO} and I_{FE} . Record values and reject devices that exceed their specified limits. In addition reject devices exceeding the following delta (Δ) change during the burn-in: $\Delta I_{FE} = \pm 15\%$, $\Delta I_{CBO} = 100\%$ or 5mA , whichever is greater. (It should be noted that the 5mA value varies from part to part in the ΔI_{CBO} rejection criteria. This number value is for the purpose of not rejecting devices which have very low initial leakage current (I_{CBO}) which can vary more than 100% during burn-in.)	All electrical parameters of each device shall be measured as listed on the manufacturer's data sheets.	MIL-STD-750 Method 1071.1, Fine Leak: Test Condition G or H Gross Leak: Test Condition C. Only for Grade 1 screening	MIL-STD-750 Method 2076	MIL-STD-750 Method 2071
b. Transistors, Silicon, PNP, Low, Medium Power, Switching or General Purpose								
c. Transistors, Silicon, PNP, High Power			Same as above except P_T at case temperature specified.					
d. Transistors, Silicon, NPN, High Power						Same as above except fine leak rejection value 5×10^{-7} atm cc/sec. Only for Grade 1 screening		Only for Grade 1 screening
e. Transistors, Field-Effect, Junction, N-Channel, Silicon	N.A.	Measure I_{GSS} , I_{DSS} and $I_{V_{FS}}$. Reject all devices that exceed limits.	168 hrs at $T_A = 175^\circ\text{C}$ at specified V_{GS} and V_{DS} . Reduce T_A below 30°C , hold for 10 min before removing voltage. (This is a high temperature reverse bias burn-in.)	Remeasure values of I_{GSS} , I_{DSS} and $I_{V_{FS}}$. Record values and reject devices that exceed their specified limits. In addition reject devices exceeding the following delta (Δ) change during the burn-in: $\Delta I_{DSS} = \pm 10\%$, $\Delta I_{V_{FS}} = \pm 20\%$ and $\Delta I_{GSS} = 100\%$ or a number value determined for each part type, whichever is greater. Note: If the max rated I_{GSS} is less than $100\mu\text{A}$, omit ΔI_{GSS} criteria.		MIL-STD-750 Method 1071.1, Fine Leak: Test Condition G or H Gross Leak: Test Condition C. Only for Grade 1 screening		
f. Transistors, Field-Effect, Junction, P-Channel, Silicon								

Table 09. (page 3 of 4)
Screening Outline for Transistors¹

Test Sequence Part Category	1 Internal Visual (Precap) Inspection	2 Initial Inspection & Electrical Parameter Measurements	3 High Temperature Storage	4 Thermal Shock (Temperature Cycling)	5 Acceleration	6 PHND ²	7 FIST ³	8 BIST ⁴	9 Seal Leak Tests
g. Transistors, Silicon, Unijunction			Store for 48 hours at T _A = 200°C. (If leads are silver or tinned the heating must be in an inert atmos- phere or reduce temperature to T _A = 125°C)	MIL-STD-750 Method 1051. (Refers user to MIL-STD-202 Method 107 for procedural details.) Test Conditions C, except 10 cycles total with 15 minutes rest at each temperature extreme.		MIL-STD-750 Method 2052 Only for Grade 1 screening	MIL-STD-750 Method 2061 Only for Grade 1 screening	MIL-STD-750 Method 2062 Only for Grade 1 screening	MIL-STD-750 Method 1071.1. Fine Leak: Test Condition G or H Gross Leak: Test Condition C. Only for Grade 2 screening.
i. Phototransistor	MIL-STD-750 Method 2072. (Since this test can only be performed by the manufacturer, specific internal visual inspection in procure- ment document.)	Visual Inspection per MIL-STD-750 Method 2071. Radiographic Inspec- tion per MIL-STD- 750, Method 2076. Measure all electrical parameters at this time.	Same as above ex- cept T _A shall be limited to manufac- turer's specified maximum storage temperature.	Same as above: except temperature extremes shall be limited to manufacturer's spec- ified minimum and maximum storage temperature.	MIL-STD-750 Method 2006 except that test shall be 20,000 g in Y ₁ orientation, one time only. The 1 min. hold- time requirement shall not apply.				MIL-STD-750 Method 1071. Fine Leak: Test Condition H. Gross Leak: Test Condition K. Only for Grade 2 Screening
j. Optically Coupled Isolator									MIL-STD-750 Method 1071.1. Fine Leak: Test Condition G or H Gross Leak: Test Condition C. Only for Grade 2 Screening

Notes:

1. For complete procurement requirements, consult your project para 243/244.
2. PHND = Particle Impact Noise Detection
3. FIST = Forward Instability Shock Test
4. BIST = Backward Instability Shock Test

Table 09. (page 4 of 4)
Screening Outline for Transistors

Part Category	Test Sequence	10	11	12	13	14	15	16	17
		Reverse Bias Burn-In	Pre Burn-In Electrical Measurements	Burn-In	Post-Burn-In Electrical Measurements	Final Electrical Parameter Measurements	Seal Leak Tests	Radiography	External Visual Examination
g. Transistors, Silicon, Unijunction		168 hrs at $T_A = 175^\circ\text{C}$ at specified V_{CE} and I_E . Reduce T_A below 30°C . hold for 10 min before removing voltage.	Measure I_{EB20} , R_{BBO} and η . Record values and reject all devices that exceed limits.	168 hrs at $T_A = 25^\circ\text{C}$ at specified V_{CE} and I_E . (Maximum rated power.)	Remeasure values of I_{EB20} , R_{BBO} and η . Record values and reject devices that exceed their specified limits. In addition reject devices exceeding the following delta (Δ) change during the burn-in: $\Delta\eta = \pm 10\%$, $\Delta R_{BBO} = \pm 20\%$ and $\Delta I_{EB20} = 100\%$ or 5 nA, whichever is greater.			MIL-STD-750 Method 2026	MIL-STD-750C Method 2072
		48 hrs at: $V_{CB} = 80\%$ of V_{CBO} $I_E = 0$, $T_A = 150^\circ\text{C}$ Reduce temperature to $T_A = 30^\circ\text{C}$ before reverse voltage is removed at end of test. Measure I_{CBO} and reject devices that exceed their specified limits.	Measure I_{CBO} and h_{FE} (inverted). Record values and reject all devices that exceed limits.	168 hrs at $T_A = 25^\circ\text{C}$ at specified V_{CE} and P_T . Max rated power dissipation at T_A .	Remeasure values of I_{CBO} and h_{FE} (inverted). Record values and reject devices that exceed their specified limits. In addition reject devices exceeding the following delta (Δ) change during the burn-in: Δh_{FE} (inverted) = $\pm 15\%$, $\Delta I_{CBO} = 100\%$ or 5 nA, whichever is greater. It should be noted that the 5 nA value varies from part to part in the ΔI_{CBO} rejection criteria. This number value is for the purpose of not rejecting devices which have very low initial leakage current (I_{CBO}) which can vary more than 100% during burn-in.)		MIL-STD-750 Method 1071.1. Fine Leak: Test Condition G or H. Gross Leak: Test Condition C. Only for Grade 1 screening		Only for Grade 1 screening
i. Phototransistor		48 hrs at: $V_{CE} = 80\%$ of V_{CEO} E_e (Incident Radiant Energy = 0) T_A (or T_C) = manufacturer's specified maximum operating temperature. Measure I_D (Dark Current) and reject devices exceeding specified limits.	Measure I_D and I_L . Record values and reject all devices that exceed specified limits.	168 hrs at T_A (or T_C) = 25°C at specified V_{CE} . Adjust E_e (incident radiant energy) for $P_T = 80\%$ of maximum continuous device dissipation at T_A (or T_C) = 25°C	Remeasure values of I_D and I_L . Reject devices that exceed specified limits or exceed the following delta limits: $\Delta I_L = \pm 25\%$ $\Delta I_D = 100\%$ or an absolute value determined for each part type, whichever is greater.	All electrical parameters of each device shall be measured as listed on the manufacturer's data sheets.	MIL-STD-750 Method 1071.1. Fine Leak: Test Condition H. Gross Leak: Test Condition K. Only for Grade 1 screening		Only for Grade 1 screening
		MIL-STD-750 Method 1019 Test Condition A. $V_{CE} = 80\%$ of V_{CEO} T_A (or T_C) = 125°C or maximum specified operating temperature, whichever is lower. (Do not bias LED during this test.) Measure I_C (OFF) within 4 hours of test completion. Reject devices that exceed specified limits.	Measure the following parameters Phototransistor I_C (OFF) I_C (ON) h_{FE} LED I_R Record values and reject devices that exceed specified limits.	168 hrs at T_A (or T_C) = 25°C at specified V_{CE} . Select an LED forward current (I _F) for a phototransistor power dissipation of $P_T = 80\%$ of maximum continuous device dissipation at T_A (or T_C) = 25°C .	Remeasure I_C (OFF), I_C (ON), h_{FE} and I_R . Reject devices that exceed specified limits or exceed the following delta limits: Phototransistor ΔI_C (ON) = $\pm 25\%$ $\Delta h_{FE} = \pm 25\%$ ΔI_C (OFF) = 100% or a number value determined for each part type, whichever is greater. Light Emitting Diode $\Delta I_R = 100\%$ or an absolute value determined for each part type, whichever is greater.		MIL-STD-750 Method 1071.1. Fine Leak: Test Condition G or H. Gross Leak: Test Condition C. Only for Grade 1 screening		

Table 10.
Screening Outline for Microcircuits¹

Two levels of screening are outlined for microcircuits. Level 1 screening is required for all non-standard parts intended for use in a grade 1 application. Level 2 screening is required for non-standard parts intended for other than grade 1 applications.

Screening Sequence	1	2 ²	3	4 ³	5	6 ⁴	7 ⁵	8 ^{6,7}
Screening Level	Internal Visual (Precap) Can only be performed by mfr. Specify requirement	Stabilization Bake	Temperature Cycling	Constant Acceleration	Particle Impact Noise Detection (PIND)	Seal	Interim Electrical Parameter Measurements	Burn-In
1	MIL-STD-883 Method 2010 Condition A	MIL-STD-883 Method 1008 Condition C	MIL-STD-883 Method 1010 Condition C	MIL-STD-883 Method 2001 Condition E. Y Orientation only.	MIL-STD-883 Method 2020 Condition A or B. Specify test condition	MIL-STD-883 Method 1014 Fine Leak: Cond. A or B. Gross Leak Cond. C. Specify test conditions	Specify DC & AC parameters and parameters requiring delta calculations	MIL-STD-883 Method 1015 240 hrs at 125°C (Dynamic) Specify test cond. and burn-in circuitry
2	Same as above except Condition B	Same as above	Same as above	Same as above	Not Required	Same as above	Measure parameters requiring delta calculations	Same as above except 160 hrs. at 125°C See note 6

Screening Sequence	9	10 ⁶	11 ⁵	12 ⁴	13
Screening Level	Interim Electrical Parameter Measurements	Reverse Bias Burn-In	Final Electrical Measurements	Radiographic	External Visual
1	Remeasure parameters specified in step 7. Specify delta limits and percent defective allowable. (PDA)	MIL-STD-883 Method 1015 Condition A or C. 72 hrs at 150°C. Specify test cond. & burn-in circuitry.	Specify DC, AC and delta measurements at 25°C, min. and max. operating temperatures.	MIL-STD-883 Method 2012	MIL-STD-883 Method 2009
2	Not Required	Not Required	Same as above	Not Required	Same as above

NOTES: 1. For complete procurement requirements, consult your project parts engineer.
2. User should be aware of tarnish problems of some lead finishes at temperatures above 150°C.
3. For microcircuit packages having an inner seal or cavity perimeter greater than 2 inches, or a mass greater than 5 grams, refer to MIL-STD-883B, Method 5004, paragraph 3.2 for acceleration instructions.
4. Seal and radiographic tests may be performed in any sequence after PIND test.
5. The parameter measurements and delta calculations required for both level 1 and level 2 screening shall include those parameters and deltas (including measurements for each parameter) specified in the MIL-M-38510 slash sheet for the selected part. If no slash sheet is available for the selected part, model the parameter and delta requirements from a slash sheet for a similar part type. If no slash sheet is available for selected or similar part types, consult the project parts engineer for recommendations.
6. For level 1 screening, the order of the burn-in in step 8 and step 10 is optional.
7. For level 2 screening, SSI and MSI MOS devices shall be exposed to both dynamic (160 hrs at 125°C) and static (160 hrs at 150°C) burn-ins in screening step 8. The order of the burn-ins is optional. For other technologies, use the burn-in method specified for Class B screening in the MIL-M-38510 slash sheet for the selected or similar part types. If no slash sheets are available for the selected or similar part types, consult the project parts engineer for recommendations.

Table 14.
Screening Outline for Thermistors¹

Test Sequence Category	1	2	3	4	5	6	7
	External Visual Examination	Initial Measurements	Bake	Temperature Cycle	Burn-In	Final Measurements and Tests	External Visual Examination
(a) Thermistors, (Thermally Sensitive Resistor) (Negative Temp. Coef.)	MIL-T-23648 Paragraph 4.3.1	Zero-Power Resistance at 25°C and IR	100 hrs at Maximum Specified Operating Temperature	MIL-STD-202 Method 107 Cond. B	Not Required	Zero-Power Resistance at 25°C	MIL-T-23648 Paragraph 4.6.1
(b) Thermistors, Fixed Silicon (Positive Temp. Coef.)		Zero-Power Resistance at 25°C	Not Required				
					1.5 x rated pwr. for 96 hrs at 25°C		

NOTE:

1. For complete procurement requirements, consult your Project Parts Engineer.

Table 15.
Screening Outline for Transformers¹

Test Sequence Category	1	2	3	4	5	Reference Documents
	Initial Measurements	Thermal Shock	Burn-In	Seal Leak Test	Final Measurements and Tests	
Transformers, Audio and Power	1. Visual Examination 2. Dielectric Withstanding Voltage (DWV) 3. Induced Voltage 4. Insulation Resistance (IR) 5. D.C. Resistance (DCR) of each winding 6. Primary Inductance (L) 7. Turns Ratio	MIL-STD-202, Method 107, Test Condition A-1. Use maximum temperature specified for transformer as maximum temperature.	Not Required	Do not perform these tests on encapsulated units. MIL-STD-202, Method 112. Test Condition C for Fine Leak. Test Condition D for Gross Leak. Use maximum temperature specified for transformer as bath temperature.	Repeat initial examinations and measurements. Reject criteria: $\Delta L > \pm 3\%$ (powder core and toroids) $\Delta DCR > \pm 3\%$ $DWV < \text{min. specified}$ $IR < \text{min. specified}$ Turns ratio must equal specified value.	MIL-T-27 MIL-STD-202
Transformers, Pulse, Low Power	1. Visual Examination 2. Dielectric Withstanding Voltage (DWV) 3. Induced Voltage 4. Insulation Resistance (IR) 5. DC Resistance (DCR) 6. Open Circuit Inductance (OCL) 7. Leakage Inductance 8. Turns Ratio	Not Required	MIL-T-21038 Para. 4.7.4	MIL-T-21038 Para. 4.7.7 (Gross Leak Test)	Repeat initial measurements and examinations. Measure turns ratio and waveform (rise time, overshoot, droop, backswing, decay time). Reject criteria: $\Delta DCR < \pm 3\%$, $DWV < \text{min. specified}$, $IR < \text{min. specified}$. Turns ratio must equal specified value. Waveform parameters must not exceed the specified maximums.	MIL-T-21038

NOTE:

1. For complete procurement requirements, consult your Project Parts Engineer.